Key:

1) Terms & Phrases that are ***both bolded and italicized*** are those for which definitions were requested by the PTC Standards Task Force.
2) Terms & Phrases that are **bolded only** were not requested by the PTC Standards Task Force, but are included because they were deemed helpful and/or significant by the PTC Implementation Task Force.
3) Glossary Reference Sources are shown in ***bolded and italicized*** text at the end of each defined term or phrase. Those denoted with a number in parentheses are referenced at the end of the document. This numerical listing is from several glossary sources, and includes sources for terms and phrases that are not included in this document.

Absolute Block - A block in which no train is permitted to enter while it is occupied by another train. ***(2)***

Absolute Signal - A signal of an automatic block signal system that is capable of displaying "Stop" as opposed to "Stop and Proceed". ***(2)***

Acceptance Testing - Formal testing conducted to determine whether or not a system satisfies its acceptance criteria and to enable the customer to determine whether or not to accept the system. ***(1)***

Accident - An unforeseen event or occurrence which causes death, injury, or damage to property or the environment.

Active - Diagnostics based on observed conditions and commanded test routines initiated by the monitoring and diagnostic system.

Active Redundancy - That redundancy wherein all redundant items are operating simultaneously rather than being activated when needed. ***(11)***

Adhesion (Coefficient Of) - During rolling contact, the ratio between the longitudinal tangential force at the wheel - rail/running surface interface and the normal force. ***(26)***

Advance Signal - A fixed signal used in connection with one or more signals to govern the approach of a train or engine to such signal. ***Canadian Rail Operating Rules (CROR)***

Advanced Civil Speed Enforcement System (ACSES) - ACSES is a program of the National Railroad Passenger Corporation (Amtrak). This system will use a carefully constructed blend of transponder scanning, radio, and microprocessor technology to meet specific needs of Amtrak=s multiple-track, high-speed Northeast Corridor. Prototype testing and final specification for procurement of the ACSES system will be completed in 1995. ACSES will supplement the new continuous 9-aspect cab signal and speed control system by enforcing civil speeds at 5 mph increments up to 150 mph and by enforcing a positive stop at interlocking home signals where an overrun stop signal could compromise an adjacent high-speed main track. It is being designed with a view toward ultimately equipping the entire Amtrak Northeast Corridor. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Advanced Railroad Electronics System (ARES) - An integrated command, control, communications,

and information system, which applies advanced avionics to the business of railroading. ARES generates efficient traffic plans, conveys them into movement instructions to engine crews and monitors actual train movements to detect deviations from plan. Designed to control rail traffic with a high degree of efficiency, precision, and safety, ARES communications flow through an automatic digital data link. The data link uses the railroad=s existing microwave and VHF radio frequencies to communicate information, instructions, and acknowledgments between the control center and a train or other track vehicle. To determine position and speed, ARES uses the Global Positioning System (GPS) being deployed by the U.S. Department of Defense. On-board GPS equipment calculates vehicle position and speed, and the digital data link conveys the data to the control center. In addition, ARES has the capability to be supported in part or totally by the strategic placement of transponder devices. The capabilities of ARES can be compared to those of ATCS. ARES was developed and demonstrated by the Burlington Northern Railroad. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Advanced Train Control Systems (ATCS) - A microprocessor/communications/transponder-based system designed to provide both safety and business functions. Safety area capabilities are: (1) the digital transmission of track occupancy/movement authority to trains and an acknowledgment from the train crew via digital radio communications in lieu of voice communications, (2) provision of positive train separation control functions to preclude the train from exceeding its assigned limits of authority, (3) protection for maintenance-of-way and other workmen on track, (4) enforcement of authorized operating speed limits for trains consistent with civil engineering and other operating constraints, including temporary slow orders. In the business-related function area, ATCS was designed to enable the transmission of work order activity related to pick-up and set-out of rail cars, locomotive health reporting, and other functions. ATCS was a joint program of the AAR and RAC. ***PTC Implementation Task Force***

Aging Factor - See IEEE Dictionary for aging. ***(26)***

Alertness Function - A device or system which monitors the operator for signs of incapacitation, usually by requiring movement or response to take place within a prescribed period of time. ***(26)***

Algorithm - A finite set of well-defined rules for the solution of a problem in a finite number of steps. ***(1)***

American Short Line and Regional Railroad Association (ASLRRA) - An organization of participating railroads that addresses issues of a common interest to short line and regional railroad operators, e.g., legislation, rulemaking, operating problems. ***Bundy - Cothen***

Anomaly - Deviation from nominal performance which does not cause a significant effect on system performance but does warrant investigation and/or repair. ***(20)***
ANPRM - Advanced notice of proposed rulemaking. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Apparatus - A device or system of devices that performs a distinct function within a basic operating unit, including a device or system of devices whose principal function is data communications. ***(26)***

Apparatus Interoperability - The ability of any specific apparatus to communicate with other

apparatuses in such a way that it can successfully replace another apparatus of the same apparatus type without any requirement for manual configuration other than the address or unique identifier of the replacement apparatus. ***(26)***

Apparatus Type - A pre-defined configuration that, when adhered to by a given apparatus, makes it possible for that apparatus to achieve apparatus interoperability, without restriction on the internal constructional details of the apparatus concerned. **(26)**

Application Software - Software designed to fulfill specific needs of a user. ***(1)***

Approach Signal - A fixed signal used in connection with one or more signals to govern the approach thereto. ***(2)***

Architecture (1)- The organizational structure of a system or component. ***(1)***

Architecture (2) - The organizational structure of a system or component. A system is a collection of components organized to accomplish a specific function or set of functions. ***IEEE Glossary, Petit - Safetran***

Architecture (3) - The structure of a system and the relationship between system components. ***Bundy B Webster=s?***

Aspect (1) - The appearance of a roadway signal conveying an indication as viewed from the direction of an approaching train; the appearance of a cab signal conveying an indication as viewed by an observer in the cab. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Aspect (Signal Aspect) (2) - The appearance of a fixed signal conveying an indication as viewed from the direction of an approaching train; the appearance of a cab signal conveying an indication as viewed by an observer in the cab. ***(2)***

Assembler - A computer program that translates programs expressed in assembly language into their machine language equivalents. ***(1)***

Assembly Language - A programming language that corresponds closely to the instruction set of a given computer, allows symbolic naming of operations and addresses, and usually results in a one-to-one translation of program instructions into machine instructions. ***(1)***

Assertions - A logical expression specifying a program state that must exist or a set of conditions that program variables must satisfy at a particular point during a program execution. Types include input assertion, loop assertion, and output assertion. ***(IEEE Standard 610.12-1990)***

Assessment - To carefully ascertain the value of a system or process. ***Bundy B Webster=s?***

Association of American Railroads (AAR) - An organization of railroads and private car lines of North America, formed to administer the collective interest of its members, i.e., legislation and rulemaking; issuance of recommended practices for motive power and equipment, signal and train control systems, communication systems, and operating rules; and assignment of radio frequencies,

which have been allocated by the Federal Communications Commission. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Audit - An independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria. ***(1)***

Augmentation - To add PTC functions to an existing system of train control. ***Bundy***

Authority - A geographical or political division created specifically for the single purpose of providing transportation service. ***(26)***

Authority Having Jurisdiction - That entity that defines the contractual (including specification) requirements for the procurement. ***(26)***

Automated Guideway Transit - Any guided transit mode with fully automated operation (i.e. no crew on the train). The term usually refers, however, only to guided modes with small and medium - sized vehicles that operate on exclusive right - of - way. ***(26)***

Automatic Block Signal System (ABS) (1) - A series of consecutive blocks that are governed by block signals, cab signals, or both, in which ABS rules apply. The signals in ABS are actuated by a train or engine, or by other conditions affecting the use of a block. ***Canadian Rail Operating Rules (CROR)***

Automatic Block Signal (ABS) System (2) - A series of consecutive blocks governed by block signals, cab signals, or both, actuated by a train, or engine, or by certain conditions affecting the use of a block. ***(2)***

Automatic Block Signal System (ABS) (3) - A series of consecutive blocks governed by block signals, cab signals, or both, actuated by a train or engine, or by certain conditions affecting the use of a block, e.g., track circuit, control circuit, switch or derail position. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Automatic Equipment Identification (AEI) - An electronic identification tag for rail equipment, which can be read by track side scanners as the equipment passes. AEI is designed to provide timely, accurate data entry to railroad computers for use as a management tool and for customer services purposes in the tracking of loaded and empty equipment. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Automatic Interlocking - An arrangement of signals, with or without other signal appliances, which functions automatically as distinguished from those functions controlled manually, and which are so interconnected by means of electric circuits that their movements must succeed each other in proper sequence, train movements over all routes being governed by signal indication. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Automatic Train Control (ATC) (1) - The method for automatically controlling train movement, enforcing train safety and directing train operations. ***(18)***

Automatic Train Control (ATC)* (2) - A system supplementing an ABS or TCS system, in which locomotives are equipped with a device so arranged that its operation will automatically result in the following: **(A)** A full service application of the brakes, which will continue either until the train is brought to a stop, or, under control of the engineer, its speed is reduced to a predetermined rate; or **(B)** When operating under a speed restriction, an application of the brakes when the speed of the train exceeds the predetermined rate and which will continue until the speed of the train is reduced to that rate. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Automatic Train Control - The system for automatically controlling train movement, enforcing train safety, and directing train operations. ATC must include automatic train protection (ATP) and may include automatic train operation (ATO) and/or automatic train supervision (ATS). ***(26)***

Automatic Train Operation (1) - That subsystem within the automatic train control system which performs any or all of the functions of speed regulation, programmed stopping, door control, performance level regulation or other functions otherwise assigned to the train operator. ***(26)***

Automatic Train Operation (ATO) (2) - The portion of an ATC system that performs any or all of the functions of speed regulation, programmed stopping, door control, performance level regulation, and other functions normally assigned to a train operator. ***(18)***

Automatic Train Protection (ATP (1)) - The portion of an ATC system that ensures safe train movement by a combination of train detection, train separation, overspeed protection and route interlocking. ***(18)***

Automatic Train Protection (ATP) (2) - That the subsystem within the automatic train control system, which maintains safe train operation through a combination of train detection, train separation, and interlockings. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Automatic Train Protection - That subsystem within the automatic train control system which maintains fail - safe protection against collisions, excessive speed, and other hazardous conditions through a combination of train detection, train separation, and interlocking. ***(26)***

Automatic Train Stop (1) - A system in which the train is brought to a stop through automatic brake application if imposed restrictions are ignored. ***(20)***

Automatic Train Stop (ATS)* (2) - A track side system working in conjunction with equipment installed on the locomotive, so arranged that its operation will result in the automatic application of the air brakes should the engineer not acknowledge a restrictive signal. If the restrictive signal is acknowledged, ATS will be suppressed. ATS supplements an ABS or TCS system. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Automatic Train Stop (3) - A wayside system that works in conjunction with equipment installed on the vehicle to apply the brakes at designated restrictions or on a dispatcher=s signal, should the operator not respond properly. ***(26)***

Automatic Train Supervision (1) - That subsystem within the automatic train control system which monitors trains, adjusts the performance of individual trains to maintain schedules, and provides data

to adjust service to minimize the inconveniences otherwise caused by irregularities. ***(26)***

Automatic Train Supervision (ATS) (2) - The portion of an ATC system that monitors system status and directs traffic movement to maintain schedules or minimize the effects of delays. ***(18)***

Auxiliary Wayside System - A back - up or secondary train control system, capable of providing full or partial automatic train protection for trains not equipped with trainborne CBTC equipment, and/or trains with partially or totally inoperative trainborne CBTC equipment. The auxiliary wayside system may also provide broken rail detection ***(26)***

Availability - The probability that a system or system element will be operational when required, expressed as the ratio of mean time between failure to the sum of mean time between failure plus mean time to restore. ***(18)***

Axle Counter - An automatic arrangement for detecting and counting car and locomotive axles that pass a given wayside location; usually makes use of a wheel detector. ***(2)***

Back-Up System - A redundant system that performs the principal functions of the primary system with minimum deviation from the performance of the primary system. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Backup - An alternate means of accomplishing a function using software, hardware, circuits or operational procedures separate from those used for the primary method. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Ballast Resistance - The resistance offered by the ballast, ties, etc. to the flow of leakage current from one rail of a track circuit to the other. ***(2)***

Base Communications Package (BCP) - A set of equipment installed at an ATCS base station site. ***Canadian Rail Operating Rules (CROR)***

Battery Voltage - That voltage which is provided within specified limits by the low voltage power supply (or, in its absence, the control voltage on - board battery).
Note - Battery voltage limits are specified in IEEE P1476. ***(26)***

Big-Bang Testing - A type of integration testing in which software elements, hardware elements, or both are combined all at once into an overall system, rather than in stages. ***(1)***

Black Box Testing - Testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions. ***(1)***

Blending - The combination of two or more modes of braking (e.g. rheostatic electric brake, regenerative electric brake and friction brake) to produce the desired total retarding effort. ***(26)***

Block - A length of track of defined limits, the use of which by trains is governed by block signals, cab signals, or both. ***(26)***

Block Limit Signal - A fixed signal, or hand signal in the absence of a fixed signal, at the entrance of a block to govern use of that block. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Block, Manual - A block established manually by signal, timetable, or mandatory directive. ***Canadian Rail Operating Rules (CROR)***

Block Signal* - A fixed roadway signal at the entrance of a block to govern trains and engines entering and using that block. The signal may be operated either automatically or manually. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Block Signal System* - A method of governing the movement of trains into or within one or more blocks by block signals or cab signals. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Block Territory - Trackage equipped with a manual block system, automatic block system or traffic control system. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Book of Rules (Or Operating Rules) - A set of codified regulations governing the conduct of railroad transportation, which defines signal indications, speeds and specific operating requirements. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Bottom-Up - Pertaining to an activity that starts with the lowest-level components of a hierarchy and proceeds through progressively higher levels; for example, bottom-up design; bottom-up testing. ***(1)***

Brake, Electric - A mode of operation of the propulsion system in which retarding is provided. NOTEBAlthough generally considered synonymous with dynamic brake, electric brake is a more global term, in that it admits of the possibility of providing retardation by drawing power from the line or other means not dependent on conversion of kinetic energy into retarding power B the key element of dynamic braking. ***(26)***

Brake, Emergency - Fail - safe, open - loop braking to a complete stop with an assured maximum stopping distance considering all relevant factors. Once the brake application is initiated, it is irretrievable, i.e. it cannot be released until the train has stopped or a predetermined time has passed. ***(26)***

Brake, Friction - The system of pneumatic, electropneumatic, hydraulic, electrohydraulic, or electric valves, controls, actuators and associated components which, in combination, provide the capability of braking the car to a stop purely by the action of friction devices upon the wheel tread, disc rotors, or other surfaces. ***(26)***

Brake, Parking - A means that supplies static braking forces to maintain a vehicle or train in a no motion state. ***(26)***

Brake, "Panic" - Using any available form of braking, whether or not fail - safe, to obtain the shortest possible stopping distance. ***(26)***

Brake, Penalty - A function of the automatic train protection portion of the master control system, accomplished by a safety critical full - service or emergency brake application. ***(26)***
NOTE - Although most commonly associated with an overspeed operating condition, it may in practice be initiated for a variety of reasons, depending on the vehicle design and the requirements of the authority having jurisdiction.

Brake, Regenerative - A form of dynamic brake in which the electrical energy generated by braking is returned to the power supply line, provided to on - board loads, or a combination thereof during the braking cycle instead of being dissipated in resistors. ***(26)***

Brake, Rheostatic - A form of dynamic brake in which the electrical energy generated by braking is dissipated as heat in on - board resistors during the braking cycle. ***(26)***

Brake, (maximum) Service - A non - emergency brake application that obtains the (maximum) brake rate that is consistent with the design of the brake system, retrievable under the control of master control. ***(26)***

Brake, Snow - A constant application of light friction brake intended to create enough heat to mitigate the buildup of snow and ice which would interfere with the brake actuators. ***(26)***

Brake, Straight Air - An arrangement of brakes whereby air is admitted from the main reservoir through a brake valve to the straight air pipe to the brake cylinders in the operating unit. ***(26)***
NOTE - In most rail transit vehicle applications, an electro - pneumatic overlay is utilized to assist in the straight air brake command transmission.

Brake, Track - A magnetic friction brake that compresses against the running rail and is activated by an electrical signal. ***(26)***

Brakes Applied - An indication that all friction brakes are applied to some agreed - upon preset level. ***(26)***

Braking Effort - That longitudinal retarding force generated by the friction brake system or the propulsion system (in electric brake). ***(26)***

Braking Distance - The maximum distance on any portion of any railroad which any train operating on such portion of railroad at its maximum authorized speed, will travel during a full service application of the brakes, between the point where such application is initiated and the point where the train comes to a stop. ***(2)***

Branch Testing - Testing designed to execute each outcome of each decision point in a computer program. ***(1)***

Bubble Chart - A dataflow, data structure, or other diagram in which entities are depicted with circles (bubbles) and relationships are represented by links drawn between the circles. ***(1)***

Builder - The entity manufacturing the product. ***(26)***

Cab Signal (system) - A signal located in the cab, indicating a condition affecting the movement of a train and used in conjunction with interlocking signals and in conjunction with or in lieu of block signals. ***(26)***

Cab Signal (1) - A device located in locomotive engineer's compartment or cab, indicating a condition affecting the movement of a train or engine and used with interlocking or block signals, or in lieu of block signals. Special instructions will be issued to govern the operation of cab signals where in use. ***Canadian Rail Operating Rules (CROR)***

Cab Signal (2) - A signal located in the engineer=s compartment or cab, indicating a condition affecting the movement of a train or engine and used in conjunction with interlocking signals and in conjunction with, or in lieu of, block signals. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Car - See: vehicle. ***(26)***

Car Builder - The entity assembling or manufacturing the vehicle. ***(26)***

Catenary - On electric railroads, the term describing the overhead conductor that is contacted by the pantograph or trolley, and its support structure. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Central Control - That place where train control or train supervision is accomplished for the entire transit system; the train command center. ***(20)***

Central Processing Unit (CPU) - The brain of a computing machine, usually defined by the arithmetic and logic units (ALU) plus a control section; often called a Aprocessor,@ sometimes a Amainframe.@ ***(19)***

Centralized Traffic Control (CTC) (1) - A traffic control system operated from a central dispatching office. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Centralized Traffic Control (CTC) (2) - A term applied to a system of railroad operation by means of which the movement of trains over routes and through blocks on a designated section of track or tracks is directed by signals controlled from a designated point without requiring the use of train orders and without the superiority of trains. ***(2)***

Certification - A written guarantee that a system or component complies with its specified requirements and is acceptable for operational use. ***(1)***

Channel - A path along which data passes or along which data may be stored serially. ***(23)***

Checked Redundancy - The implementation of a function (usually safety-critical) via the use of multiple independent channels, typically having a common input and performing identical functions, in which the channel outputs are compared such that any difference/disagreement is detected (immediately or at certain intervals). A detected disagreement causes the system to revert to a safe state. ***(18)***

Civil Speed Restriction - The maximum speed authorized for each section of track, as determined

primarily by the alignment, profile, and structure. ***(26)***

Civil Speed - The maximum speed allowed in a specified section of track or guideway as determined by physical limitations of the track/guideway structure, train design, and passenger safety. ***(PTC Implementation TF)***

Closed Loop Principle - The principle of control system design in which the response of a system (feedback) is continuously compared with the controlling signal to generate an error signal. ***(15)***

Closed Loop Braking - Braking under continuous direction of the train control system. ***(20)***

Cluster Controller (CC) - A ground network mode (in ATCS) responsible for the control of BCPS. ***Canadian Rail Operating Rules (CROR)***

Coast - The mode of operation of a vehicle or train in which both tractive effort from the propulsion system and braking effort from the propulsion and friction brake systems are zero. ***(26)***

Cock - A pneumatic device having two positions, closed/shut and open/through. ***(26)***

Code (Rail) - The controlled pulsing of electrical energy in a line or track circuit, usually for the purpose of transmitting information. The pulses may be on/off or polarized, or both, and may also vary in duration. ***(2)***

Code Review - A meeting at which software code is presented to project personnel, managers, users, customers, or other interested parties for comment or approval. ***(1)***

Code Safety Analysis (CSA) - An analysis of program code and system interfaces for events, faults, and conditions that could cause or contribute to undesirable events affecting safety. ***(27)***

Code (Software) - In software engineering, computer instructions and data definitions expressed in a programming language or in a form output by an assembler, compiler, or other translator. ***(1)***

Code System - The non-vital apparatus and circuits used for forming, transmitting, receiving, and applying the codes of a supervisory control system. ***(2)***

Coded Track Circuit - A track circuit in which the electrical energy is varied or interrupted periodically. ***(4)***

Color Light Signal - A fixed signal in which the indications are given by the color of a light only. ***(4)***

Command Speed (Speed Command) - The speed imposed upon a moving vehicle or train at a given point in time by the automatic train control system. ***(11)***

Command - Any message that causes the receiving party to perform an action. ***(27)***

Common Mode Failure - Where separate or redundant processes fail because of some event or condition which affects them all. ***(22)***

Communication Protocols (1) - Data protocols that provide sufficient security, throughput, and accuracy. ***PTC Supplier Q=s***

Communication Protocols (2) - Convention used for establishing transmission rules. Protocols are used to achieve the security, throughput, and accuracy as specified in the safety and performance requirements of the PTC system. ***IEEE Glossary, Petit - Safetran***

Communication Protocols (3) - Data communication protocols that provide routing, error recovery, flow control, and security. ***Frank Wilson - Rockwell***

Communication Protocols (4) - The format in which digital data is packaged into messages, and the management of message flow, including any error detection/correction features that may be used. ***Bob Heggestad - Harmon***

Communications - Based Train Control - A continuous automatic train control system utilizing: high resolution train location determination, independent of track circuits; continuous, high capacity, bi - directional train - to - wayside RF data communications; and trainborne and wayside vital processors. ***(26)***

Commuter Rail - A passenger railroad service that operates within metropolitan areas on trackage that usually is part of the general railroad system. The operations, primarily for commuters, are generally run as part of a regional system that is publicly owned or by a railroad company as part of its overall service. ***(26)***

Compiler - A computer program that translates programs expressed in a high order language into their machine language equivalents. ***(1)***

Component Testing - Testing of individual hardware or software components or groups of related components. ***(1)***

Computer Aided Dispatching (CAD) (1) - A computer-based dispatching system providing automatic train routing and in some installations, a paperless dispatcher environment. CAD contributes by guarding against the inadvertent conflicts in train movement authorities. CAD systems typically consist of computer hardware and specialized software programs designed for railroad applications. CAD systems may have enhanced existing TCS capabilities through a number of subsystems. Trains can be tracked and recorded automatically, and written movement authorities, where necessary, can be generated, recorded and filed completely within the computer system. These activities provide an added enhancement to train operations safety. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Computer Aided Dispatching (2) - A term relating to use of computers in centralized traffic control systems to aid the dispatching of trains. ***(2)***

Computer Program - A combination of computer instructions and data definitions that enable computer hardware to perform computational or control functions. ***(1)***

Computer Instruction - A statement in a programming language, specifying an operation to be performed by a computer and the addresses or values of the associated operands; for example, Move A to B. ***(1)***

Computer Software Configuration Item (CSCI) - An aggregate of software that is designated for configuration management and is treated as a single entity in the configuration management process. ***(IEEE Standard 610.12-1990)***

Concept Level - The level of analysis activities at which vital functions and vital implementation requirements, imposed on the system=s design and implementation by the safety assurance concept selected, are determined and identified. ***(26)***

Concept/Conceptual - The period of time in the software development cycle during which the user needs are described and evaluated through documentation (for example, statement of needs, advance planning report, project initiation memo, feasibility studies, system definition, documentation, regulations, procedures, or policies relevant to the project). ***(27)***

Configuration Control - Ensures that any change, modification, addition, or amendment is prepared, accepted, and controlled by set procedures. ***(22)***

Configuration Management - A process to assure that all documentation which describes a system and its various components is current and reflects the actual functional and physical characteristics of the system throughout its life cycle. ***(20)***

Conflicting Routes - Two or more routes, opposing, converging, or intersecting, over which movements cannot be made simultaneously without possibility of collision. ***(2)***

Consist (1) - The makeup or composition (number and specific identity) of a train of vehicles. (14)

Consist (2) - The makeup or composition (number and specific identity) of individuals units of a train. ***(26)***

Constant Warning Time Device - A device used as a part of a highway grade crossing warning system to provide a relatively uniform warning time. ***(2)***

Constant Power Load - A load that demands a constant power from the LVPS/battery even when the voltage value drops such as when switching from the LVPS to the battery. ***(26)***
Note B Usually present for loads that have their own built in regulator such as propulsion control voltage supply.

Continuous Speed Control - A speed control concept which involves the continuous updating of the maximum allowable instantaneous train speed based on the train's current and precise location. ***(18)***

Continuous Train Control - A type of control in which the locomotive (or engine control) apparatus is constantly in operative relation with the track elements and is immediately responsive to a change of conditions in the controlling section which affects train movement. ***(2)***

Continuous Train Control System - A locomotive or self - propelled car apparatus that is constantly in contact with wayside control apparatus and is immediately responsive to a change of conditions in the controlling section that affects train movement. ***(26)***

Control Flow - The sequence in which operations are performed during the execution of a computer program. ***(1)***

Control Flow Diagram - A diagram that depicts the set of all possible sequences in which operations may be performed during the execution of a system or program. Types include box diagram, flowchart, input-process-output chart, state diagram. ***(1)***

Control Office Systems (1) - PTC Systems that use central data gathering and analysis to monitor and authorize on-track movements over major portions of railroad. ***Bob Heggestad - Harmon***

Control Office Systems (2) - Systems that use central data gathering and analysis to determine enforcement requirements for on-track movements. ***PTC Supplier Q=s***

Control Voltage - That voltage which is provided for operating the controlling elements of the train. See: battery voltage. ***(26)***
NOTE - This may or may not be the same potential value as the battery voltage.

Controlled Point - A location where signals or other functions of both a traffic control system are controlled from the control machine. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Controlled Manual Block System - A series of consecutive blocks governed by block signals, controlled by continuous track circuits, operated manually upon information by telegraph, telephone or other means of communication, and so constructed as to require the cooperation of the signalmen at both ends of the block to display a Aclear@ or a Apermissive@ block signal. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Controls - An active processing of commands or inputs, relaying a request to a subsystem for action. ***(26)***

Core Features of PTC - To: (1) Prevent train-to-train collisions (positive train separation); (2) enforce speed restrictions, including civil engineering restrictions and temporary slow orders; and (3) provide protection for roadway workers and their equipment operating under specific authorities. ***PTC Working Group***

Correctness - The degree to which a system or component is free from faults in its specification, design, and implementation. ***(1)***

Corridor Risk Assessment Model (CRAM) - A model developed by the Volpe National Transportation Systems Center for the Federal Railroad Administration. The focus of this modeling effort was to determine whether required implementation of PTC systems would reduce certain accident risk potentials on specific rail corridors. The model provides input into that analysis in the form of forecast PTC preventable accident rates for the Class I network, and forecasts average consequences of

those accidents. ***Bundy***
Corridor - A route on a railroad system with defined origination and destination points. ***Bundy***

Coupler Interface - That facility of an basic operating unit that is designed to provide convenient connection to and disconnection from any other basic operating unit without requiring disassembly of any constituent part of either basic operating unit. This includes standardized mechanical, electrical, electronic, pneumatic, and other interfaces as required. ***(26)***

Coverage, C - A measure of the system ability to detect faults and/or errors. ***BRS-DePaepe (Giras?)***

Critical Design Review (CDR) - A review conducted to verify that the detailed design of one or more configuration items satisfy specified requirements; to establish the compatibility among configuration items and other items of equipment, facilities, software, and personnel; to assess risk areas for each configuration item; and, as applicable, to assess the results of the producibility analyses, review preliminary hardware product specifications, evaluate preliminary test planning, and evaluate the adequacy of preliminary operation and support documents. ***(IEEE Standard 610.12-1990)*** For Computer Software Configuration Items (CSCIs), this review will focus on the determination of the acceptability of the detailed design, performance, and test characteristics of the design solution, and on the adequacy of the operation and support documents. ***(27)***

Critical Software - Software whose failure could have an impact on safety, or could cause large financial or social loss. ***(1)***

Criticality - The degree of impact that a requirement, module, error, fault, failure, or other item has on the development or operation of a system. ***(1)***

Crossover - Two turnouts with the track between the frogs arranged to form a continuous passage between two nearby and generally parallel tracks. ***(2)***

Current of Traffic - Railroad slang for the direction of traffic flow along a track segment, which is favored by the signal system and track structure in place. Railroad traffic can operate in either direction along a track segment. However, the signal system arrangement and the placement of certain track structure components, i.e., turnouts, may favor the movement of traffic in a particular direction. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Cut Out - The state of being disabled by the conscious use of a cutout device or function. ***(26)***

Cutout - A device or function whose purpose is deliberately to disable a specified device or function, e.g. “dynamic brake cutout.” ***(26)***

D. basic operating unit - A single vehicle designed for independent operation.
E. A permanent or semi - permanent combination, designed for independent operation, consisting of two or more vehicles of one or more types.

Daily Operating Bulletin (DOB) - Instructions regarding track condition restrictions and other information which affect the safety and movement of a train or engine within limits indicated in the

timetable or specified in special instructions. ***Canadian Rail Operating Rules (CROR)***

Dark Territory - Trackage that is non-signaled, over which the movement of trains are governed by timetable, train orders/track warrants, or operating rules for the movement of trains in other than block signal territory. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Data Flow Analysis - A graphical analysis technique to trace behavior of program variables as they are initialized, modified, or referenced while the program executes. (8)

Data Flow Diagram - A diagram that depicts data sources, data sinks, data storage, and processes performed on data as nodes, and logical flow of data as links between the nodes. ***(1)***

Data Recording/Recorder - The act of or device used to record data of any type. ***(26)***

Data Structure - A physical or logical relationship among data elements, designed to support specific data manipulation functions. ***(1)***

De-centralized - A control system configuration in which safety and non-safety critical functions are allocated to numerous local areas rather than confined to a single central location. ***(18)***

Dead Spot - A location where the transmission of radio is not always achieved for reasons of the presence of terrain, tunnels, low areas with heavy foliage, as well as locations with atmospheric or other conditions creating interference. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Deadlock - A situation in which computer processing is suspended because two or more devices or processes are each awaiting resources assigned to the other. ***(IEEE Standard 610.12-1990)***

Deadman - A pressure or activity actuated alertness device to detect inattention or disability of a train operator. ***(26)***

NOTE - The feature can be contained within the master controller main handle grip, obtained by a separate foot switch, or obtained through an alertness type function. The device, when not properly maintained in an operational condition, will result in an emergency or full service brake application.

Deadman Control - A pedal or handle, or both, one of which must be kept in a depressed position while a locomotive is operating; usually the brake-valve handle and a pedal which the engineman can conveniently keep depressed at his seat. When pressure is released from both at the same time they function to cut off the power and apply the brakes. ***(4)***

Debug - To detect, locate, and correct faults in a computer program. Techniques include use of breakpoints, desk checking, dumps, inspection, reversible execution, single-step operation, and traces. ***(1)***

Decoder - A device which transforms a received signal into a data format. ***(20)***

Decoupling - The process of making software modules more independent of one another to decrease the impact of changes to, and errors in, the individual modules. ***(1)***

Demodularization - In software design, the process of combining related software modules, usually to optimize system performance. ***(1)***

Dependability - A measure of the degree to which an item is operable and capable of performing its required function at any (random) time during a specified mission profile, given item availability at the start of the mission. (7)

Derail Detector - A device so arranged as to detect a derailment condition. ***(26)***

Design - The process of defining the architecture, components, interfaces, and other characteristics of a system or component. ***(1)***

Design Review - A process or meeting during which a system, hardware, or software design is presented to project personnel, managers, users, customers, or other interested parties for comment or approval. Types include critical design review, preliminary design review, system design review. ***(1)***

Desk Checking - A static analysis technique in which code listings, test results, or other documentation are visually examined, usually by the person who generated them, to identify errors, violations of development standards, or other problems. ***(1)***

DGPS (1) - A system that uses Global Positioning Satellites to relate objects to specific locations, but that has differential enhancements. See also GPS. ***Bundy***

DGPS (2) - An enhancement to the Global Positioning System using differential techniques to improve accuracy. Differential techniques improve radio navigation system accuracy by determining position error at a known location and subsequently transmitting the determined error, or corrective factors, to users of the same radio navigation system, operating in the same area. ***1993 Report to the Secretaries of Defense and Transportation; Petit B Safetran***

Diagnostics - The process of determining the cause of a fault from symptoms. ***(26)***

Differential GPS - An application of the Global Positioning System, in which a ground-based radio transmission is utilized to correct or calibrate the position determined by reference to satellite-based transmissions, increasing accuracy of positioning. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Digital Data Radio - A system for the transmission of electronic data via radio. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Digital Data Communication (1) - The flow of information in digital form between nodes, subsystems or other components of a system. ***Bob Heggestad BHarmon***

Digital Data Communication (2) - The control of digital data as it moves from sender to receiver, and includes: detection and correction of errors that may be introduced along the transmission path; management of data traffic; and priority schemes to ensure that the most important data arrives first

at the receiver. ***Bundy??***

Digital Data Communication (3) - A transmission mode in which data is represented by binary digits rather than by an analog signal. For PTC systems, digital data communication will be enhanced by specific protocols necessary to support the safety and performance requirements. ***Business Data Communications B David Stamper; Petit - Safetran***

Direct Traffic Control - A method of operation wherein the train dispatcher issues mandatory directives to establish limits of train movement authority in a series of consecutive blocks that may be signaled or non-signaled. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Distributed/Zone Systems (1) - PTC Systems that use localized data gathering and analysis to monitor and authorize on-track movements over limited portions of railroad. ***Bob Heggestad, Harmon***

Distributed/Zone Systems (2) - A design in which all data is not processed in one processor. Multiple processors in the master station or remote stations, or both, share the functions. ***IEEE; John Vogler***

Distributed/Zone Systems (3) - Systems that may have responsibility for non-contiguous portions of the railroad and may or may not be physically located along the wayside. ***PTC Supplier Q=s***

Distributed/Zone Systems (4) - Systems in which the safety logic processing is not performed by a single central processor. Multiple processors, in the central office or wayside, or both, share the functions. ***John Vogler, NJT***

Distributed/Zone Systems (5) - The geographic distribution of hardware, software, processing, data, and control. For PTC, distributed systems are characterized by geographically distributed controllers along the right of way with each controller having responsibility for on-track protection within a specific geographic zone. ***Petit - Safetran***

Diversity (Diverse Redundancy) - In fault tolerance, realization of the same function by different means. For example, use of different processors, storage media, programming languages, algorithms, or development teams. ***(1)***

Division - A defined territory of a railroad under the jurisdiction of a superintendent or manager of operations. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Door Control - Circuitry, including such safeguards and interlocks as required, which operates to open and close car doors. ***(20)***

Doors Closed - A state, as given by trainline signal indication, in which doors are fully closed and locked. ***(26)***

Doors Locked - The condition reached in the door closing cycle when the drive has achieved a

latching condition that will hold doors closed mechanically until a door opening cycle is initiated. ***(26)***

Doors Open - A state, as given by trainline signal indication, in which doors are not fully closed and locked. ***(26)***

Double Track Line - Two main tracks on which trains operate in either direction. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Down-Time - The period of time during which a system or component is not operational or has been taken out of service. ***(1)***

Dual Channel (Computer) System - A system incorporating one or perhaps more computer(s) in each of two data paths—represents a form of hardware redundancy.

Dual Control Switch - A switch equipped for powered operation, also equipped for hand operation. ***Canadian Rail Operating Rules (CROR)***

Dwell Time - The time a transit unit (vehicle or train) spends at a station or stop, measured as the interval between its stopping and starting. ***(26)***

Dynamic Analysis - The process of evaluating a system or component based on its behavior during execution. ***(1)***

Dynamic Braking - A method of braking in which the motor is used as a generator and the kinetic energy of the apparatus is employed as the actuating means of exciting a retarding force. ***(2)***

Electric Locking - The combination of one or more electric locks and controlling circuits by means of which levers of an interlocking machine are locked, or the equivalent using circuits only, so that switches, signals, or other units operated in connection with signaling and interlocking, are secured against operation under certain conditions. ***(2)***

Electric Switch Lock - An electric lock connected with a hand-operated switch to prevent its operation until the lock is released. ***Canadian Rail Operating Rules (CROR)***

Electric Brake - See: brake, electric. ***(26)***

Electric Coupler - A device used to allow trainline signals to be transmitted from vehicle to vehicle or unit to unit in a train, with the connection of trainlines performed automatically when vehicles are coupled. ***(26)***

Electronic Data Interchange (EDI) - The transmission of electronic data regarding rail shipments among rail shippers and carriers. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Electronic Communications System (ECS) - A system that may be used for the recording, verification, and transmission of instructions or information affecting the movement of trains, engines, or track units. ***Canadian Rail Operating Rules (CROR)***

Embedded Software - Software that is part of a larger system and performs some of the requirements of that system; for example, software used in an aircraft or rapid transit system. ***(1)***

Emergency - A condition which could cause bodily harm or severe physical injury to persons, and/or serious damage to equipment. ***(11)***

Emergency Brake - See: brake, emergency. ***(26)***

Emergency Braking - Irrevocable open-loop braking to a complete stop, at the maximum safe braking rate for the system (typically at a higher rate than that obtained with a service brake application). ***(18)***

Emergency Stop - The stopping of a train by an emergency brake application which, after initiated, cannot be released until the train has stopped. ***(20)***

Emulator - A model that accepts the same inputs and produces the same outputs as a given system. ***(1)***

Encoder - A device that transforms the format of the supplied data into the format required for transmission. ***(20)***

Entity Relationship Diagram - A diagram that depicts a set of real-world entities and the logical relationships among them. ***(1)***

Error (1)- The difference between a computed, observed, or measured value or condition and the true, specified, or theoretically correct value or condition. ***(1)***

Error (2)- An error is the manifestation of a fault. Specifically, an error is a deviation from accuracy or correctness. ***BRS-DePaepe (Giras?)***

Error Correction - In data transmission, the process of changing one or more bits of information in a digital message to its (their) correct value.

Error Detection - In data transmission, the process of detecting one or more erroneous/invalid bits of information in a digital message.

Error Seeding - The process of intentionally adding known faults to those already in a computer program for the purpose of monitoring the rate of detection and removal, and estimating the number of faults remaining in the program. ***(1)***

Event Recorder - An on - board device/system with crash - worthy memory which records data to support accident/incident analysis. ***(26)***

Fade - (A) The condition occurring during a braking cycle at low speed wherein the fundamental characteristics of the propulsion system utilized will not support the power requirement of the level of dynamic electric brake called for. Consequently, the level of dynamic electric brake actually generated

decreases as a function of speed along an inherent characteristic. ***(26)***(B) In electric braking systems capable of supporting the level called for to zero (0) speed, a deliberately - created characteristic wherein the level of electric brake decreases as a function of speed to allow a smooth transition to friction brake for the purpose of the final stop.

Fail-Operational - A characteristic design which permits continued operation in spite of the occurrence of a discrete failure. ***(6)***

Fail-Operational Fail-Safe - A system characteristic which permits continued operation on occurrence of a failure while remaining acceptably safe. A second like failure results in the system remaining safe, but non-operational. ***(6)***

Fail-Safe (1) - A characteristic of a system or its elements whereby any failure or malfunction affecting safety will cause the system to revert to a state that is known to be safe. ***(18)***

Fail-Safe (2) - A design philosophy applied to safety critical systems such that the result of hardware failure or the effect of software error shall either prohibit the system from assuming or maintaining an unsafe state, or shall cause the system to assume a state known to be safe. ***(26)***

Fail-safe (3) - A design philosophy applied to safety-critical systems such that the result of a hardware failure or the effect of software error shall either prohibit the system from assuming or maintaining an unsafe state or shall cause the system to assume a state known to be safe. ***(26)***

Fail-Safe (4) - The concept of a self-checking circuit can be defined in mathematical terms. The definition begins by specifying the input domain and output space for the self-checking circuit. Let us call the input domain and the output range in normal operation the input code space and the output code space, respectively. The input code space will be designated by , while represents the output code space. The output of a circuit under consideration is defined by a logic function of input in the fault-free operation. will change to if the fault develops in the circuit. We assume a prescribed set, , of faults which may develop in the circuit [1]. A circuit is called fault-secure with respect to if and only if

(1) or

for any and [1]. This definition implies that never takes an incorrect output value in . Inversely, when belongs to the output code space, it necessarily takes a correct value. A circuit is called self-testing with respect to if and only if

(2), , [1]

By observing an output that does not belong to the output code space, we know that a fault has occurred in the circuit. Therefore, Equation (2) means that whether the circuit contains a fault of or not can always be tested by at least one normal input.

Based on the two definitions above, the self-checking circuit is defined as a circuit is self-checking with respect to if and only if it is fault-secure and self-testing [1].

There is a class of circuits called fail-safe circuits in close connection with the self-checking circuit. In the context of fail-safe circuits, a set of the so-called safe outputs is defined. This set, designated by , may or may not be a subset of . Then, a circuit is called fail-safe with respect to if and only if

(3), , or [1]

When , the condition above is the same as that of the fault-secureness. The clear difference

between the self-checking circuit and the fail-safe circuit is that the existence of the test by at least one normal input is required in the former, but not in the latter [1]. ***Tohma, Yoshihiro, Fault-Tolerant Computing Theory and Techniques Volume I, Chapter 5, Prentice-Hall, 1986, D.K. Pradhan, editor, pp. 361-362.***

Fail Safe Design - A term used to designate a design principle of any system, the objective of which is to eliminate the hazardous effects of a failure by having the failure result in nonhazardous consequences. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Fail-safely - The implementation of a function in a fail-safe manner. ***(26)***

Fail-Soft - Pertaining to a system or component that continues to provide partial operational capability in the event of certain failures; for example, a traffic light that continues to alternate between red and green if the yellow light fails. ***(1)***

Failure (1) - Partial or complete loss of component, subsystem or system capability, resulting in equipment being unable to perform some or all of its intended function.
Note: Failures can be major, where total loss of equipment capability results, or minor, where equipment remains operable but with reduced capability or where the failure is resettable. Failures can occur in equipment which is being observed by the M&D system, termed equipment failure, or in some element of the M&D system itself, termed M&D failure. M&D failures can be further divided into two categories: monitoring failures and diagnostic failures. Monitoring failures can be divided into FRA monitoring failures, where a failure to record an FRA - required parameter has occurred (where FRA requirements apply) or, diagnostic monitoring failures, where a failure to record a non - FRA required parameter has occurred. ***(26)***

Failure (2)- The inability of a system or component to perform its required functions within specified performance requirements. ***(IEEE Standard 610.12-1990)***

Failure (3)- If an error causes the system to perform incorrectly, then the system has failed. A failure is a deviation in the expected performance of the system. These will be classified as either safe or unsafe. ***BRS-DePaepe (Giras?)***

Failure Analysis - The logical and systematic examination of a system to identify and analyze the probability, causes, and consequences of potential and real failure. ***(20)***

Failure Mode - The physical or functional manifestation of a failure. For example, a system in failure mode may be characterized by slow operation, incorrect outputs, or complete termination of execution. ***(1)***

Failure Mode and Effects Analysis (FMEA) (1) - An inductive procedure in which potential malfunctions are identified and then analyzed as to their possible effects. ***(6)***

Failure Mode and Effects Analysis (FEMA) (2) - An analysis of the potential hazards associated with the failure of any component within a system, including tracking the effects of this failure to determine its ultimate consequences. ***Galdo***

Failure Mode, Effects and Criticality Analysis (FMECA)(1) - An extension of an FMEA in which each effect is assigned a criticality index which reflects both the probability of the occurrence of the effect and the seriousness of the effect in terms of loss in performance and/or safety. ***(6)***

Failure Mode and Effects Criticality Analysis (FEMCA) (2) - An analysis of the potential hazards associated with the failure of any component within a system, including tracking the effects of this failure to determine its ultimate consequences. It takes into account the importance of each component failure using probability of failure occurrence to identify those sections of the system where failures are more important. ***Galdo***

Failure Rate - Rate at which failures occur as a function of time. If the failure rate is constant, it is frequently expressed as the reciprocal of mean-time-between-failure (MTBF). ***(20)***

Failure Tolerance - The ability of a system or subsystem to perform its function(s) or maintain control of a hazard in the presence of failures within its hardware, firmware, or software. ***(27)***

False Proceed (False Clear) - A failure of a system, device or appliance to indicate or function as intended which results in less restriction than is required. ***(2)***

Fatal Error - An error that results in the complete inability of a system or component to function. ***(1)***

Fault (1) - Any change in state of an item that is considered to be anomalous and may warrant some type of corrective action. Examples of faults included device errors reported by Built-In Test (BIT)/ Built-In Test Equipment (BITE), out-of-limits conditions on sensor values, loss of communication with devices, loss of power to a device, communication error on bus transaction, software exceptions (e.g., divide by zero, file not found), rejected commands, measured performance values outside of commanded or expected values, an incorrect step, process, or data
definition in a computer program, etc. Faults are preliminary indications that a failure may have occurred. ***(27)***

Fault (2) - A status condition outside normal or expected parameters. ***(26)***

Fault (3) - A fault is a physical defect, imperfection, or flaw that occurs in hardware or software. ***BRS-DePaepe (Giras?)***

Fault (4) - A defect in a hardware device or component or an incorrect step, process, or data definition in a computer program. ***(1)***

Fault Avoidance - Avoiding the insertion of errors into a computer program or system.

Fault Containment - Where a failure/fault in one part of a program (or system) is prevented from causing failure/faults in other parts of the system. ***(22)***

Fault Detection - A process that discovers or is designed to discover faults; the process of determining that a fault has occurred. ***(27)***

Fault Isolation - The process of determining the location or source of a fault. ***(27)***

Fault Masking - A condition in which one fault prevents the detection of another. ***(1)***

Fault Rate, l - The instantaneous rate of fault occurrence for any unit (e.g. a component, a PCB, a subsystem, or even a system), given that the unit has survived until time t. Mathematically, the fault rate is found by determining the fraction of units expected to be operational at time t but which are expected to fail in the interval from t to t + Dt. The fault rate function is then found by taking the limit as Dt approaches zero. ***BRS-DePaepe (Giras?)***

Fault Recovery - A process of elimination of a fault without permanent reconfiguration. ***(27)***

Fault Tolerance - The built-in capability of a system to provide continued (full or limited) operation in the presence of a limited number of faults or failures. ***(18)***

Fault Tree Analysis (1) - An analytical technique, whereby an undesired system state is specified and the system is then analyzed in the context of its environment and operation to find all credible ways in which the undesired event could occur. (16)

Fault Tree Analysis (2) - A structured analysis method used to identify software and hardware components at the implementation level used in the implementation of vital functions. ***(26)***

Firmware (1) - Computer programs and data loaded in a class of memory that cannot be dynamically modified by the computer during processing. ***(27)***

Firmware (2) - The combination of a hardware device and computer instructions and data that reside as read-only software on that device. ***(1)***

Fixed Block (Control System) - A system control concept in which track or guideway is divided into sections of various fixed lengths, and trains are maintained at headways based in part on the presence of other trains in the various sections of track or guideway. ***(18)***

Fixed-Block Operation - A length of track of defined limits into which no other train is permitted, while it is occupied. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Flag Protection - A method of manually protecting trains to avoid collisions during an emergency or unusual operating conditions. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Flexible Block Operation - A length of track of variable limits into which no other train is permitted, while it is occupied. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Flow Chart - A control flow diagram in which suitably annotated geometrical figures are used to represent operations, data, or equipment, and arrows are used to indicate the sequential flow from one to another. ***(1)***

Foreign Trains - Any train not belonging to the particular railway on which it is running. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Form, Fit, and Function - In configuration management, that configuration comprising the physical and functional characteristics of an item as an entity, but not including any characteristics of the elements making up the item. ***(1)***

Formal Analysis - Use of rigorous mathematical techniques to analyze the algorithms of a solution. The algorithms may be analyzed for numerical properties, efficiency, and/or correctness. (8)

Formal Testing - Testing conducted in accordance with test plans and procedures that have been reviewed and approved by a customer, user, or designated level of management. ***(1)***

Forward - The direction of motion of the train corresponding to the direction of vision of an operator or attendant when occupying his or her normal position in a normal orientation. ***(26)***
NOTE - For an unattended vehicle, forward may be defined by the prevailing direction of operation on the guideway segment being utilized.

FRA Compliant Event Recorder - As defined by CFR 49 Part 229 (May 5, 1995), paragraph 229.5 g). ***(26)***

Friction Brake - See: brake, friction. ***(26)***
Frog (2) - A track structure used at the intersection of two running rails to provide support for wheels and passageways for their flanges, thus permitting wheels on either rail to cross the other. ***(2)***

Frog (1) - A component of the track structure, which allows the flanges of rolling stock wheels to pass from main line rail into turnouts, or from turnouts back onto main line rail. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Full Service Braking - A non-emergency brake application which obtains the maximum brake rate consistent with the design of the primary brake system(s). ***(20)***

Full Field - In a propulsion system, the motor connection in which, for series motors, the exciting field current is the same as the armature current, or, for separately excited motors, the exciting field current is at its maximum value. ***(26)***

Function - A defined objective or characteristic action of a system or component. ***(1)***

Functional Fault Tree - A structured analysis method used to identify vital functions at the system functional level by identifying all system functional faults which could precipitate hazards. ***(26)***

Functional Testing - Testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions. ***(1)***

Functional Specification - A document that specifies the functions that a system or component must perform. Often part of a requirements specification. ***(1)***

Functional Level - The level of analysis activities at which vital system functions are identified from system functional and operational requirements. ***(26)***

General Bulletin Order(s) (GBO) - Instructions regarding track condition restrictions and other information that affect the safety and movement of a train or engine. GBO applies in OCS and CTC. It may also apply in other methods of train control where specified in special instructions. ***Canadian Rail Operating Rules (CROR)***

Glass Box Testing - Testing that takes into account the internal mechanism of a system or component. Types include branch testing, path testing, statement testing. ***(1)***

Global Positioning System (GPS) (1) - A satellite-based radio navigation system deployed and operated by the Department of Defense, which provides highly accurate three-dimensional position, velocity, and time data to users worldwide. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

GPS (2) - A system that uses Global Positioning Satellites to relate objects to specific locations. See also DGPS. ***Bundy***

GPS (3) - A satellite-based radio navigation system deployed and operated by the Department of Defense. GPS provides highly accurate three-dimensional position, velocity, and time to users. ***1993 Report to the Secretaries of Defense and Transportation; Petit B Safetran***

Grade Crossing - A crossing of highways, railroad tracks, other fixed guideways or pedestrian walks or combinations of these at the same level. ***(14)***

Grade-Separation - A separation of intersecting streams of traffic by the provision of crossing structures or underpasses. ***(14)***

Guideway - The surface or track, and the supporting structure, in or on which vehicles travel and which provides lateral control. ***(11)***

Hamming Distance - The number of positions in two binary words of the same length with different binary characters/values.

Hard Failure - A failure that results in complete shutdown of a system. ***(1)***

Hardware Redundancy - The existence of more than one means in hardware of accomplishing a given function.

Hardware Diversity - The existence of different hardware devices (e.g. processors) in redundant channels.

Hardware Failure - A change in the characteristics of a system hardware element which results in undesired system operation. ***(26)***

Hazard Analysis - A systematic analysis of a system operation performed to identify hazards and

make recommendations for their elimination or control during all life-cycle phases. ***(20)***

Hazard Severity - A qualitative measure or the worst potential consequences that could be caused by a specific hazard. ***(20)***

Hazard - An existing or potential condition that can result in a mishap. ***(26)***

Hazard Probability - The probability that a hazard will occur during the planned life of the system. ***(20)***

Hazard (1) - An existing or potential condition that can result in an accident. ***(21)***

Hazard (2) - Existing or potential condition that can result in or contribute to a mishap. ***(27)***

Hazard Resolution - The analysis and subsequent actions taken to reduce, to the lowest level practical, the risk associated with an identified hazard. ***(20)***

Hazardous Command - A command whose execution (including inadvertent, out-of-sequence, or incorrectly executed) could lead to an identified critical or catastrophic hazard, or a command whose executions can lead to a reduction in the control of a hazard (including reduction in failure tolerance against a hazard or the elimination of an inhibit against a hazard). ***NASA Software Safety Standard, NSS 1740.13***

Head End Power - Train - lined auxiliary power provided from a locomotive to other cars in the train. ***(26)***

Headway (1) - The time interval between the passing of the front ends of successive vehicles or trains moving along the same lane or track in the same direction. ***(26)***

Headway (2) - The time separation between two trains traveling in the same direction on the same track, measured from the instant the head end of the leading train passes a given reference point until the head end of the train immediately following passes the same reference point. ***(15)***

Health - Summary information regarding the current ability of a system or subsystem to perform its intended function. ***(26)***

Heavy Rail Vehicle - A vehicle operating on a heavy rail transit system. Typically, electrically propelled, bi - directional, capable of operating in multiple unit, and designed for rapid, high - level boarding and discharging of passengers. ***(26)***

Heavy Rail Transit - A mode of rail rapid transit generally characterized by fully grade - separated construction, operation on exclusive rights of way, and station platforms at the floor level of the vehicles. ***(26)***

Hi-Rail Vehicle - A truck or automobile with retractable flanged wheels so it may be used on either highway or railroad track. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

High-Speed - Velocity of up to 198 km/h or 125 mph.

High-Speed Rail - A rail transportation system which operates at speeds in excess of 198 km/h or 125 mph.

High Level Language (High Order Language) - A programming language that requires little knowledge of the computer on which a program will run, can be translated into several different machines languages, allows symbolic naming of operations and addresses, provides features designed to facilitate expression of data structures and program logic, and usually results in several machine instructions for each program statement. ***(1)***

Highway Grade Crossing - An intersection of a highway with a railroad track at the same elevation. ***(2)***

Highway Grade Crossing Signal - An electrically operated signal used for the warning of highway traffic at railroad-highway grade crossings. ***(2)***

Highway Grade Crossing Warning System - An interconnection of various devices and their controls used to indicate the approach and/or presence of a train at a highway grade crossing. ***(2)***

Home Signal - A fixed signal at the entrance of a route or block to govern trains or engines entering and using that route or block. ***(2)***

Host Machine - A computer used to develop software intended for another computer. ***(1)***

Hot Box/Journal - Railroad slang for an overheated journal bearing. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Hot Box/Journal Detector - A heat sensitive device installed along railroad mainline track at strategic locations for measuring the relative temperatures of passing journal bearings. Bearing temperatures are transmitted to wayside stations and are monitored by personnel who can act to stop a train if an overheated journal is discovered. Some hot box detectors will automatically drop the next block signal to a stop indication if an overheated condition is noted, thus stopping the train to allow for an inspection. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Human Factors - A multi disciplinary effort to develop information about human capabilities and limitations and to apply this information to equipment, systems, facilities, procedures, jobs, environments, training, staffing, and personnel management for safe and effective human performance. ***GAO B RCED-98-7***

Hump Yard - A railroad classification yard in which the classification of cars is accomplished by pushing them over a summit, known as a hump, beyond which they run by gravity and are switched into selected tracks. ***(2)***

HVAC Compressor Pull Down - The condition wherein the air conditioning system in the car is turned on and is required to cool a car that has been setting in the heat of the day. ***(26)***
NOTE B This condition usually presents the highest/longest sustained power demands to the auxiliary inverter.

ICC - Interstate Commerce Commission. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Impedance Bond - An iron core coil of low resistance and relatively high reactance, used on electrified railroads to provide a continuous path for the return propulsion current around insulated joints and to confine the alternating current signaling energy to its own track circuit. ***(2)***

Implementation Level - The level of analysis activities at which all system components implementing vital functions are identified and analyzed to verify that all functions identified as vital are implemented fail - safely. ***(26)***

Independent Operation - The ability, when supplied with appropriate energy, and with control signals from internal sources or through one or more coupler interfaces, to perform all of the functions of which the installed equipment is intended to be capable. ***(26)***

Independent Verification and Validation (IV&V) - Verification and validation performed by an organization that is technically, managerially, and financially independent of the development organization. ***(1)***

Independent Verification and Validation (IV&V) - A process whereby the products of the software development life cycle phases are independently reviewed, verified, and validated by an organization that represents the acquirer of the software and is completely independent of the provider. ***NASA Software Safety Standard, NSS 1740.13***

Inertial Navigation (1) - A process in which devices sensing movement and spatial orientation are used in combination with a track database to help determine location of a vehicle. ***Bob Heggestad BHarmon***

Inertial Navigation (2) - Dead-reckoning navigation using inertial sensors to measure accelerations. Location, direction, distance, and speed are determined by computers that use initial or subsequent location fixes along with a data base to determine precise location. ***John Vogler, NJT; IEEE***

Inertial Navigation (3) - Sophisticated orientation equipment, ***used in concert with a track database (Wilson B Rockwell doesn=t like)***, which relates an on-track movement to a specific location. ***PTC Supplier Q=s***

Inertial Navigation (4) - Guidance (as of an aircraft or spacecraft) by means of self-contained automatically controlling devices that respond to inertial forces. **Note:** This can be used with other systems, such as GPS or fixed reference transponders, to provide absolute location information. ***Webster=s; Petit - Safetran***

Informal Testing - Testing conducted in accordance with test plans and procedures that have not been reviewed and approved by a customer, user, or designated level of management. ***(1)***

Inhibit - A design feature that provides a physical interruption between an energy source and a function (e.g., a relay or transistor between a battery and a pyrotechnic initiator, a latch valve

between a propellant tank and a thruster, etc.). ***NASA Software Safety Standard, NSS 1740.13***

Inspection - A static analysis technique that relies on visual examination of development products to detect errors, violations of development standards, and other problems. ***(1)***

Insulated Rail Joint - A joint in which electrical insulation is provided between adjoining rails. ***(2)***

Integration Testing - Testing in which software components, hardware components, or both are combined and tested to evaluate the interaction between them. ***(1)***

Interface - See IEEE Dictionary. ***(26)***

Interface Analysis - An analysis of module interfaces and associated variables. ***(16)***

Interface Testing - Testing conducted to evaluate whether systems or components pass data and control correctly to one another. ***(1)***

Interline Service Management (ISMK) - Railroad Aindustry level@ systems development to foster the implementation of business processes and supporting information systems that will allow interchange of goods or passengers between carriers to provide reliable, competitive, seamless service. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Interlock - Hardware or software function that prevents succeeding operations when specific conditions exist. ***NASA Software Safety Standard, NSS 1740.13***

Interlocking (1) - An arrangement of interconnected signals and signal appliances for which interlocking rules are in effect. ***Canadian Rail Operating Rules (CROR)***

Interlocking (2) - An arrangement of signals and signal appliances/systems so interconnected that their movements must succeed each other in proper sequence, train movements over all routes being governed by signal indications. Interlockings may be either automatically or manually controlled. Manual interlockings are controlled from an interlocking machine that must be operated for each train movement. Automatic interlockings are designed with inherent powers that function by means of electric/electronic circuits to perform the functions of a manual interlocking. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Interlocking (3) - An arrangement of signals and signal appliances so interconnected that their movements must succeed each other in proper sequence and for which interlocking rules are in effect. It may be operated manually or automatically. ***(2)***

Interlocking (4) - An arrangement of switch, lock and signal devices that is located where rail tracks cross, join, separate, and so on. The devices are interconnected in such a way that their movements must succeed each other in a predefined order, thereby preventing opposing or conflicting train movements. ***(26)***

Interlocking Machine - An assemblage of manually operated levers or equivalent devices, for the control of signals, switches or other units, and including mechanical or circuit locking or both to

establish proper sequence of movements. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Interlocking Signal - A fixed signal at the entrance to or within interlocking limits to govern the use of the routes. ***Canadian Rail Operating Rules (CROR)***

Intermittent (Train) Control - A type of control in which the locomotive (or controlling car) apparatus is affected only at certain designated points, usually at signal locations. ***(2)***

Intermittent (Discrete, Stepped) Speed Control - A speed control concept which involves the establishment of the maximum allowable train speed for a given section of track or guideway. ***(18)***

Intermittent Fault - A temporary or unpredictable fault in a component. ***(1)***

Intermodal Service - Carriage of a vehicle, container or passenger successively by two or more modes of transportation (e.g., ocean-going ship, railroad, air and highway). Involves transportation partnerships among differing transport modes, such as between the highway mode, railroads, and transoceanic shipping. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Interoperability (1) - To enable railroad to railroad interchange at track speed. To be considered interoperable, the system must have: similar but not necessarily identical human-machine interfaces; compatible communications interfaces; a minimally common set of external messages; and minimally acceptable content and format of required databases.***IDOT Document***

Interoperability (2) - The capability of a locomotive or other vehicle to move between adjoining areas of different PTC systems at track speed, with no significant change in performance or operator interface. ***Bob Heggestad BHarmon***

Interoperable (3) - As applied to signal and train control systems, including PTC, the ability which permits trains equipped with the same or similar systems to operate on all railroads interchangeably and automatically without hindrance, delay or additional on-board equipment. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Interpreter - A computer program that translates and executes each statement or construct of a computer program before translating and executing the next. ***(1)***

Interrupt - The suspension of a process to handle an event external to the process. ***(1)***

Interstate Commerce Commission (ICC) - Predecessor to the Surface Transportation Board (STB), an independent agency of the U.S. Government responsible for designated transportation regulatory functions. The ICC/STB is the predecessor of the FRA with respect to administration and enforcement of the Federal railroad safety laws and regulations. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

ITCS - Incremental Train Control System. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Joint Operations - Railroad operations involving more than one railroad company, as at interlockings or other facilities jointly-owned, maintained or operated. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Latent - Present and capable of becoming though not now visible or active ***(23)***.

Latent Fault - A latent fault is one that is present in a system but has not yet produced an error. In other words, a latent fault has not yet produced any effect. ***BRS-DePaepe (Giras?)***

Layup Condition - Idle condition of the equipment and systems between service operating requirements ***(26)***

Life Cycle - The period of time that starts when a software product is conceived and ends when the software is no longer available for use. The software life cycle traditionally has eight phases: Concept and Initiation; Requirements; Architectural Design; Detailed Design; Implementation; Integration and Test; Acceptance and Delivery; and Sustaining Engineering and Operations. ***NASA Software Safety Standard, NSS 1740.13***

Light - emitting diode - See IEEE Dictionary. ***(26)***

Light Rail Transit - A mode of rail transit characterized by its ability to operate on exclusive rights - of - way, street running, center reservation running, and grade crossings and to board and discharge passengers at track or vehicle floor level. ***(26)***

Light Rail Vehicle - A vehicle which operates on a light rail transit system, capable of boarding and discharging passengers at track or vehicle floor level. ***(26)***

Line Replacement Unit (LRU) - A unit which is designated by the plan for maintenance to be removed upon failure from a larger entity (equipment, system) in the latter=s operational environment. ***IEEE; John Vogler***

Liquid Crystal Display - See IEEE Dictionary. ***(26)***

Load Weighing - A function incorporated in the propulsion or friction brake system which measures changes in sprung vehicle weight. Its purpose is to permit control of tractive effort in order to achieve a constant effort - to - weight ratio for a given master control command. ***(26)***

Locked Rotor Current - See IEEE Dictionary ***(26)***

Machine Code - Computer instructions and data definitions expressed in a form that can be recognized by the processing unit of a computer. ***(1)***

Machine Language - A language that can be recognized by the processing unit of a computer. Such a language usually consists of patterns of 1's and 0's, with no symbolic naming of operations or addresses. ***(1)***

Macro - In software engineering, a predefined sequence of computer instructions that is inserted into

a program, usually during assembly or compilation, at each place that its corresponding macro instruction appears in the program. ***(1)***

Magnetic Levitation - Levitation of a vehicle by magnetic force; it may be either by magnetic attraction or repulsion. ***(11)***

Maintainability - The characteristics of a system which enable it to be repaired and restored to operating condition after a component malfunction or failure; maintainability is often expressed in terms of the time to repair and restore operation. ***(11)***

Maintenance-of-Way (MOW) - Having to do with the installation and maintenance of track and related structures to facilitate the operation of trains. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Malfunction - Any anomaly or failure wherein the system, subsystem, or component fails to function as intended. ***(20)***

Malicious Fault - A fault that is guaranteed to produce an unsafe system failure if the system has no fault detection capability. ***BRS-DePaepe (Giras?)***

Manual Block Signal System *(1)* - A block or a series of consecutive blocks, governed by block signals operated manually, upon information by telegraph, telephone or other means of communication. ***(2)***

Manual Block Signal System (2) - A block signal system wherein the use of each block is governed by block signals controlled manually or by block-limit signals or both upon information by telephone or other means of communication. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Manual Interlocking - An arrangement of signals and signal appliances operated from an interlocking machine and so interconnected by means of mechanical and/or electric locking that their movements must succeed each other in proper sequence, train movements over all routes being governed by signal indication. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Manual Train Control - An operating mode in which the train responds to the actions of its operator through manipulation of the brake valve or master controller. ***(20)***

Manufacturer - See: builder ***(26)***

Master Control - The trainborne device or system directly providing the control signals to the train. ***(26)***

Master Controller - A physical device utilized by a human operator to provide the master control of a train. ***(26)***

Mean-Time-Between-Failures (MTBF) - The average time that a system or component will operate without failure or malfunction; the mean time between failures is the quotient of the operating time

over the number of failures, and is a measure of reliability. ***(11)***

Mean Time Between Hazardous Events (MTBHE) - The average time between unsafe system failures. Mathematically, it can be defined as (4) for a system with a failure rate, l, and a coverage, C. ?? ***BRS-DePaepe (Giras?)***

Mean-Time-To-Repair (MTTR) - The expected or observed time required to repair a system or component and return it to normal operations. ***(1)***

Memory Map - A diagram that shows where programs and data are stored in a computer's memory. ***(1)***

Message Set - The set of messages that flow between PTC system components to support PTC functionality. ***PTC Supplier Q=s***

Method of Operation - The authority for the movement of trains, e.g., signal indications, timetable and train orders, track warrants, etc. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Methodology - A particular procedure or set of procedures ***(23)***.

Metric (Software) - A quantitative measure of the degree to which a system, component, or process possesses a given attribute. ***(1)***

Migration - The transition from an old system to a new system, including the timetable that will govern the process. ***Bundy***

Minimum Safe Headway - The minimum headway at which two consecutive vehicles can be operated in accordance with a specific safe stopping policy. Headways often assume that the lead vehicle cannot stop instantaneously and are determined on the basis of the maximum deceleration rate for a failed vehicle. ***(11)***

Mishap - An unplanned event or series of events that results in death, injury, occupational illness, or damage to or loss of equipment, property, or damage to the environment; an accident. ***NASA Software Safety Standard, NSS 1740.13***

Mishap - An unplanned event or series of events resulting in death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment. ***(26)***

Mobile Systems (1) - Vehicle-carried systems which exchange information with other elements of a PTC system and with the vehicle and its operator to provide the on-board information and enforcement functions. ***Bob Heggestad BHarmon***

Mobile Systems (2) - On-board systems that evaluate and act upon the data required to perform enforcement. ***PTC Supplier Q=s***

Mobile Communications Package (MCP) (3) - A vehicle-carried communications package that

allows transmission and reception of data with other elements of a PTC system and with the vehicle and its operator to provide the on-board information and enforcement functions. ***Galdo B Bundy***

Modularity - The degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components. ***(1)***

Modular Programming - A software development technique in which software is developed as a collection of modules. ***(1)***

Module - A separately identified part of a computer program which performs a specific function; also a program unit that is discrete and identifiable with respect to compiling, combining with other units, and loading. ***(22)***, ***(1)***

Monitoring - The measurement of parameters which are then available for storage, display and/or processing. ***(26)***

Motion Sensitive Device - A device used to sense the presence, motion and direction of travel of a train. A device used to detect the movement of a train. ***(2)***

Movement Authority - The authority given to a train to enter and travel through specific section of track. This authority may be given to a train operator via manual communication, wayside signal, and/or through display on an on - board device; or may be given to an on - board device that controls the movement of the train automatically. ***(26)***

Movement by Signal Indication (MSI) - A system in multi track ABS, in which MSI rules apply. ***Canadian Rail Operating Rules (CROR)***

Moving Block System - A system control concept in which the separation of trains is based upon their relative velocity and location. ***(18)***

MTBHE - Acronym for AMean Time Between Hazardous Events@. ***Bundy***

MTBWF - Acronym for AMean Time Between Wrong-side Failures@. ***Bundy***

Multiple Unit - A system of simultaneous control of all vehicles in a consist from one master control through the means of trainlines. ***(26)***
Multi track - Two or more main tracks on the same subdivision. ***Canadian Rail Operating Rules CROR)***

N-version Programming - The independent generation of N _ 2 functionally equivalent software programs (called versions) from the same initial specification.

National Rail System - The general system of rail transportation, consisting of interconnected trackage of all rail carriers that provide interline service. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Negative Testing - Software Safety Testing to ensure that the software will not go to a hazardous

state or generate outputs that will create a hazard in the system in response to out of bound or illegal inputs. ***NASA Software Safety Standard, NSS 1740.13***

Network Communication Timing - See IEEE Dictionary ***(26)***

No-Go Testing - Software Safety Testing to ensure that the software performs known processing and will go to a known safe state in response to specific hazardous situations. ***NASA Software Safety Standard, NSS 1740.13***

No Motion - A safety - critical function utilized to indicate that the train is at zero speed or sufficiently close to zero speed to be considered "no motion". It is used to inhibit the ability of the doors to open when the train is moving, and can be used for functions such as emergency brake reset which may require an indication of the "no motion" condition. ***(26)***

Non-volatile (Memory) - Memory which does not require power to retain the stored data. ***(10)***

Non-vital Circuit - Any circuit the function of which does not affect the safety of train operation. ***(2)***

Northeast Corridor (NEC) - That the segment of tracks extending between Washington, D.C. and Boston, MA and certain connecting lines. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

NOTEBThe inherent design characteristics of some propulsion systems will require that a negligible level of electric brake be present in the coast mode.

NPRM - Notice of proposed rulemaking. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Object Code - Computer instructions and data definitions in a form output by an assembler or compiler. An object program is made up of object code. ***(1)***

Occupancy Control System (OCS) - A system in which OCS rules apply. ***Canadian Rail Operating Rules (CROR)***

On-Board - A device or system contained in the locomotive, train, or other mobile unit of a train control system. ***John Vogler, NJT***

On-Board Bus (1) -A physical electronic path handling the most robust flow. ***Frank Wilson B Rockwell***

On-Board Bus (2) -An on-board electronic path that provides or supports the data flow requirements among processor, servers, communication device, and peripherals. ***Galdo***

On-board Bus (3) - A physical electronic path that will support the most robust data flow requirement on-board. ***PTC Supplier Q=s***

On-board Bus (4) - The physical electronic path that provides data flow between the on-board

intelligence unit and other components of mobile systems. *Bob* ***Heggestad B Harmon***

On-Board Intelligence Unit (1) - On-Board processing systems which meet the service demands for the variety of PTC requirements. ***PTC Supplier Q=s***

On-Board Intelligence Unit (2) - The main processor portion of a mobile system. ***Bob Heggestad B Harmon***

Open Loop - No feedback control. ***(20)***

Operating Rules - See ABook of Rules.@ ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Operating System - A collection of software, firmware, and hardware elements that controls the execution of computer programs and provides such services as computer resource allocation, job control, input/output control, and file management in a computer system. ***(1)***

Operational Status - Summary information regarding the current ability of a system or subsystem to perform its intended function. ***(26)***

Overlay - To supplement, or overlay, an existing system of train control with a PTC system.***Bundy B NASA Software Safety Standard, NSS 1740.13***

Overspeed (1) - a speed greater than the maximum authorized speed for the locomotive, cars, track, or components; often associated with an overspeed penalty brake application. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Overspeed (2) - In excess of maximum allowable safe command speed.

Overspeed Protection - The enforcement of existing speed limits. ***(18)***

Pantograph - A current collecting apparatus having a long contact shoe which glides perpendicular to the underside of an overhead contact wire. ***(11)***

Parallel - In a propulsion system, the motor connection in which the final parallel or series - parallel motor connection is achieved and the maximum voltage available is supplied to the individual motors. ***(26)***

Parking Brake - See: brake, parking. ***(26)***

Parse - To determine the syntactic structure of a language unit by decomposing it into more elementary subunits and establishing the relationships among the subunits. For example, to decompose blocks into statements, statements into expressions, expressions into operators and operands. ***(1)***

Passenger Information Sign - A device which displays, annunciates or communicates transit trip information to passengers, also, between passengers and vehicle crew. ***(26)***

Passive - Diagnostics based on observed conditions.

Path Analysis - Analysis of a computer program to identify all possible paths through the program, to detect incomplete paths, or to discover portions of the program that are not on any path. ***(1)***

Path Testing - Testing designed to execute all or selected paths through a computer program. ***(1)***

Penalty Brake - See: brake, penalty.***(26)***

Performance Specification - A document that specifies the performance characteristics that a system or component must possess. These characteristics typically include speed, accuracy, and memory usage. Often part of a requirements specification. ***(1)***

Performance Analysis - An assessment activity intended to determine operational status. ***(26)***
Performance Standards **-** The objective and measurable outcomes that a system or component must achieve. ***(PTC Implementation TF)***

Performance Testing - Testing conducted to evaluate the compliance of a system or component with specified performance requirements. ***(1)***

Peripheral (Device) - A supplementary item of equipment that puts data into, or accepts data from, the computer. ***(19)***

Permanent Fault - A fault that occurs at time t and has an infinite duration. ***BRS-DePaepe (Giras?)***

Permissive Block (1) - A block in manual or controlled manual territory, based on the principle that a train other than a passenger train may be permitted to follow a train other than a passenger train in the block. ***(2)***

Permissive Block (2) - A block in manual or controlled manual territory, which may permit a train, other than a passenger train, to follow a train, other than a passenger train, in the block, in accordance with prescribed rules. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Personal Computer Memory Card International Association - An association to standardize methods for connecting peripherals to portable computers. ***(26)***

Petri Net - An abstract, formal model of information flow, showing static and dynamic properties of a system. A Petri net is usually represented as a graph having two types of nodes (called places and transitions) connected by arcs, and markings (called tokens) indicating dynamic properties. ***(1)***

Pneumatic Brake Pipe - A pressurized air line, continuous the length of the train, used variously to indicate train integrity, provide indication of a emergency condition, equalize reservoir pressures, or propagate a brake application signal. ***(26)***

Point Detector - A circuit controller which is part of the switch operating mechanism and operated

by a rod connected to a switch, derail or movable point frog to indicate that the point is within a specified distance of the stock rail. ***(2)***

Positive Train Control (PTC) - A generic term (and acronym) used to describe any processor-based system of train control that will: (1) Prevent train-to-train collisions (positive train separation); (2) enforce speed restrictions, including civil engineering restrictions and temporary slow orders; and (3) provide protection for roadway workers and their equipment operating under specific authorities. ***PTC Implementation TF***

Positive Train Separation **(PTS)** - This term was initially coined by the National Transportation Safety Board (NTSB) to describe any system of train control that will prevent train-to-train collisions. The term is employed by the Union Pacific Railroad and Burlington Northern Santa Fe Railroad to denote a test program for positive train control on certain of their lines in the States of Oregon and Washington. ***PTC Implementation TF***

Positive train separation - One of three core features of a PTC system. ***PTC Implementation TF***

Power "Knock Out" - An indication, derived from friction brakes being applied above a low preset level on any truck, to remove propulsion power on every vehicle in the train. ***(26)***

Power-Operated Switch - A switch equipped for powered operation, but not equipped for hand operation. ***Canadian Rail Operating Rules (CROR)***

Preliminary Design Review (PDR) - A review conducted to evaluate the progress, technical adequacy, and risk resolution of the selected design approach for one or more configuration items; to determine each design's compatibility with the requirements for the configuration item; to evaluate the degree of definition and assess the technical risk associated with the selected manufacturing methods and processes; to establish the existence and compatibility of the physical and functional interfaces among the configuration items and other items of equipment, facilities, software, and personnel; and as appropriate, to evaluate the preliminary operation and support documents. ***(IEEE Standard 610.12-1990)*** For CSCIs, the review will focus on: (1) the evaluation of the progress, consistency, and technical adequacy of the selected architectural design and test approach, (2) compatibility between software requirements and architectural design, and (3) the preliminary version of the operation and support documents.

Preliminary Hazard Analysis (PHA) (1) - Analysis performed at the system level to identify safety-critical areas, to provide an initial assessment of hazards, and to identify requisite hazard controls and follow-on actions. ***NASA Software Safety Standard, NSS 1740.13***

Preliminary Hazard Analysis (PHA) (2) - An analysis performed to obtain an initial risk assessment of a concept or system. ***(20)***

Product Standard - A standard that defines what constitutes completeness and acceptability of items that are used or produced, formally or informally, during the software engineering process. ***(1)***

Program - A combination of computer instructions and data definitions that enable computer hardware to perform computational or control functions. ***(1)***

Program Stop - A train stop preceded by closed-loop braking such that the train is stopped at a designated point according to a predetermined speed-distance profile. ***(20)***

Programmable Read Only Memory - Memory which can both be read from and reprogrammed.

Proof of Correctness - A formal technique used to prove mathematically that a computer program satisfies its specified requirements. ***(1)***

Propulsion System - The system of motors, drive mechanisms, controls, and other devices that propels or retards a vehicle. ***(26)***

Protocol - A set of conventions that govern the interaction of processes, devices, and other components within a system. ***(1)***

Prototype - A preliminary type, form, or instance of a system that serves as a model for later stages or for the final, complete version of the system. An item of equipment which is built to test a new design and which is to perform in essentially the same way as a production model. ***(1, 11)***

PTC Preventable Accidents (PPA) - Accidents that a railroad industry group of subject matter experts determined to be preventable by PTC systems. ***Bundy***

Purchaser - The entity which contractually acts as the customer. ***(26)***

Qualification Testing - Testing conducted to determine whether a system or component is suitable for operational use. ***(1)***

Qualitative Proof of Safety - Proof provided by the application of safety assurance methodologies that hazards are eliminated or controlled to an acceptable level. The norms for acceptability are usually based upon U.S. MIL-STD-882 or similar documents. ***(2)***

Quality Assurance - A planned and systematic pattern of all actions necessary to provide adequate confidence that an item or product conforms to established technical requirements. ***(1)***

Quality Control - The discipline which insures the manufacture of a uniform product within specified defect limits in accordance with design requirements. ***(20)***

Quantitative Proof of Safety - A measure of safety stated in terms of a MTBHE AMean Time Between Hazardous Events@ or MTBWF AMean Time Between Wrong-side Failures@, usually obtained by mathematical analysis of the safety assurance mechanism(s) used in the product/system, or by modeling and simulation techniques applied to the hardware and software of the product/system. ***(2)***

Radio Frequency Spectrum (1) - The entire range of electromagnetic communications frequencies administered by the Federal Communications Commission, including those used by radio, radar, and television . Several frequencies have been allocated to the railroad industry for the transmission of voice and digital data in connection with railroad operations. By agreement, the AAR serves as the

clearing house for assignment of voice radio channels in order to prevent radio interference among the users. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Radio Frequency Spectrum (2) - The range of electromagnetic communications frequencies, including those used by radio, radar, and television administrated by the Department of Communication Canada or the Federal Communication Commission (FCC); several frequencies have been allocated to industry for transmission of voice and digital data. ***Canadian Rail Operating Rules (CROR)***

Rail Safety Enforcement and Review Act (RSERA) - Public Law 102-365, enacted September 3, 1992. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Random Failure - A failure whose occurrence is unpredictable except in a probabilistic or statistical sense. ***(1)***

Reasonableness (Validity) Test - Software which verifies that the results being produced by other software are within certain specified ranges.

Rebuilt - See: remanufactured (vehicle) ***(26)***
Recovery - The restoration of a system, program, database, or other system resource to a state in which it can perform required functions. ***(1)***

Recovery Block - A programming technique in which software errors are detected in a portion of the computer program and control is transferred to a “spare” portion of software performing the same function.

Redundancy (1) - The existence in a system of more than one means of accomplishing a given function. ***(11)***

Redundancy (2) - The existence in a system of more than one means of accomplishing a given function. ***(26)***

Redundant System - A piece of equipment or a system that duplicates the essential function of another piece of equipment or system to the extent that either may perform the required function regardless of the state of operation or failure of the other. ***(11)***

Regenerative brake - See: brake, regenerative. ***(26)***

Regenerative Braking - A form of dynamic braking in which the kinetic energy of the motor and driven machinery is returned to the power-supply system. (14)

Regression Testing - Selective retesting of a system or component to verify that modifications have not caused unintended effects and that the system or component still complies with its specified requirements. ***(1)***

Reliability (1) - The ability of a system or component to perform its required functions under stated conditions for a specified period of time. ***(1)***

Reliability (2) - The probability that a system will perform its intended functions without failure, within design parameters, under specific operating conditions, and for a specific period of time. (26) **NOTE** - The ambient environmental conditions for operation are specified by the authority having jurisdiction, or, in the absence of such specifications, by IEEE P1478.

Reliability Assessment - An analytical determination of numerical reliability of a system or portion thereof without actual demonstration testing. Such assessments usually employ mathematical modeling, use of available test results, and some use of estimated reliability figures. ***(20)***

Remanufactured (vehicle) - A vehicle that, in order to extend its service life, has been structurally restored and had installed new or remanufactured components totaling a cost of 60% or more of then - prevailing vehicle replacement costs. ***(26)***
NOTE - The act of rebuilding or remanufacturing is to be interpreted as a major rehabilitation, tantamount, in certain regulatory contexts, to building anew. It should not be confused with overhaul, which is to be interpreted as a scheduled maintenance action implicit in the defined service life of the vehicle.

Replacement (1) - To replace an existing system of train control with a PTC system. ***Bundy***

Replacement (2) - A component or system used in place of an existing component or system. ***John Vogler, NJT***

Requirements Analysis - The process of studying user needs to arrive at a definition of system, hardware, or software requirements. ***(1)***

Resistive load - Loads that are resistive in nature wherein the current draw presented to the LVPS/ battery vary proportionally to the source voltage. ***(26)*** **NOTE** B These loads will demand less current when the source voltage is switched from the LVPS to the battery. Typically, relays fall into this category.

Response Time - See IEEE Dictionary. ***(26)***

Retarder - A braking device built into a railway track to reduce the speed of cars. This can be done by means of brake shoes which, when set in position, press against the sides of the lower portion of the wheels. ***(2)***

Reverse - The direction of operation which is opposite to forward. ***(26)***

Reverser - (A) The portion of the master controller used to change the commanded direction of train movement. ***(26)***(B) A circuit device used to change motor connections in order to change the direction of motor rotation and thus train movement.

RF - Radio Frequency. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Risk (1) - A measure of the severity and likelihood of an accident. ***(22)***

Risk (2). As it applies to safety, exposure to the chance of injury or loss. It is a function of the possible frequency of occurrence of the undesired event, of the potential severity of resulting consequences, and of the uncertainties associated with the frequency and severity. As it applies to safety, exposure to the chance of injury or loss. It is a function of the possible frequency of occurrence of the undesired event, of the potential severity of resulting consequences, and of the uncertainties associated with the frequency and severity. ***NASA Software Safety Standard, NSS 1740.13***

Risk Analysis - The development of a quantitative estimate of risk based on engineering evaluation and mathematical techniques for combining estimates of incident consequences and frequencies. ***(25)***

Risk Assessment - The process by which the results of a risk analysis (i.e., risk estimates) are used to make decisions, either through relative ranking of risk reduction strategies or through comparison with risk targets. ***(25)***

Road Miles - Route miles of trackage, over which a railroad provides service. (Compare number of track miles, e.g., one road mile of double track equals two track miles.) ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Robustness (1)- The degree to which a system or component can function correctly in the presence of invalid inputs or stressful environmental conditions. ***(1)***

Robustness (2) -The quality of a train control device or system to withstand a hostile environment. ***Galdo***

Route Integrity - The condition whereby a track/guideway section is safe for the entry and passage of a train. ***(18)***

Route Selection (Automatic Switching for Classification Yards) - Term is applied to a desired track destination established for an individual cut of cars by operation of a push button or other selective device. ***(2)***

Routine - A subprogram that is called by other programs and subprograms. ***(1)***

Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances (RS&I) - Rules and regulations promulgated under the authority of the Signal Inspection Act that governs Signal and Train Control Systems. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Safe (1) - The condition of a system, device or appliance that results in an indication or function equal to or more restrictive than is intended**.** ***(26)***

Safe (2) - A safe failure mode is when the system detects that a fault or an error exists and performs a complete shutdown that will result in a fail-safe action. ***BRS-DePaepe (Giras?)***

Safe (3) - The condition of a system, device or appliance that results in an indication or function equal to or more restrictive than is intended. ***(26)***

Safe Stopping Distance - The maximum distance which any train, operating under worst case tolerances and conditions, will travel from the point where braking is initially requested to where the train comes to a complete stop. ***(18)***

Safety (1) - Freedom from danger. ***(18)***

Safety (2)- Freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment. ***(26)***

Safety (3) - Freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment. ***(26)***

Safety, (2) S(t)?? - The probability that a system will either perform its functions correctly or will discontinue its functions in a manner that does not disrupt the operation of the other systems or compromise the safety of any people associated with the system. ***BRS-DePaepe (Giras?)***

Safety Analysis - A systematic and orderly process for the acquisition and evaluation of specific information pertaining to the safety of a system. ***NASA Software Safety Standard, NSS 1740.13***

Safety Architectural Design Analysis (SADA) - Analysis performed on the high-level design to verify the correct incorporation of safety requirements and to analyze the Safety-Critical Computer Software Components (SCCSCs). ***NASA Software Safety Standard, NSS 1740.13***

Safety Assurance (1) - A characteristic of the implementation of a system which assures a level of safe operation. ***(26)***

Safety Assurance (2) - A characteristic of the implementation of a system which assures a level of safe operation. ***(26)***

Safety Assurance Concept (1) - A design concept applied to processor-based systems which assures the fail-safe implementation of identified functions, including safe operation in the presence of hard-ware failures and/or software errors. ***(26)***

Safety Assurance Concept (2) - A design concept applied to processor - based systems which assures the fail - safe implementation of identified functions, including safe operation in the presence of hardware failures and/or software errors. Examples are: Checked Redundancy; Diversity and Self - Checking; Numerical Assurance; and N - Version Programming. ***(26)***

Safety Audit - An independent assessment of processes, activities, and documentation related to the safety assurance of specific systems or equipment.

Safety Critical - A term applied to a system or function, the correct performance of which is critical to safety of personnel and/or equipment; also a term applied to a system or function, the incorrect performance of which could cause or allow a hazardous condition to exist. ***PTC Implementation Task Force***

Safety Critical - A term applied to a system or function, the correct performance of which is critical to safety or personnel and/or equipment; also a term applied to a system or function, the incorrect performance of which may result in a hazard. See: fail - safe.
NOTE - Such a designation may require the incorporation of additional special safety design features. ***(26)***

Safety-Critical Computer Software Component (SCCSC) - Those computer software components (processes, modules, functions, values or computer program states) whose errors (inadvertent or unauthorized occurrence, failure to occur when required, occurrence out of sequence, occurrence in combination with other functions, or erroneous value) can result in a potential hazard, or loss of predictability or control of a system. ***NASA Software Safety Standard, NSS 1740.13***

Safety Critical Function - A function or system whose failure may result in a hazardous condition if its failure is not determined. ***Wilson - Rockwell***

Safety Critical Monitor - A monitoring process whose failure prevents the detection of hazardous conditions but does not in itself cause a hazardous condition. ***Wilson - Rockwell***

Safety-Critical Software - Software that: (1) Exercises direct command and control over the condition or state of hardware components; and, if not performed, performed out-of-sequence, or performed incorrectly could result in improper control functions (or lack of control functions required for proper system operation), which could cause a hazard or allow a hazardous condition to exist. (2) Monitors the state of hardware components; and, if not performed, performed out-of-sequence, or performed incorrectly could provide data that results in erroneous decisions by human operators or companion systems that could cause a hazard or allow a hazardous condition to exist. (3) Exercises direct command and control over the condition or state of hardware components; and, if performed inadvertently, out-of-sequence, or if not performed, could, in conjunction with other human, hardware, or environmental failure, cause a hazard or allow a hazardous condition to exist. ***NASA Software Safety Standard, NSS 1740.13***

Safety Detailed Design Analysis (SDDA). - Analysis performed on Safety-Critical Computer Software Components to verify the correct incorporation of safety requirements and to identify additional hazardous conditions. ***NASA Software Safety Standard, NSS 1740.13***

Safety Validation (1) - A process or set of activities performed on a completed system, software or hardware element to demonstrate compliance with safety requirements.

Safety Validation (2) - A structured and managed set of activities which demonstrate that the system, as specified and implemented, performs the intended functions and that those functions result in overall safe operation. Validation answers the question, “Did we build the right system?” ***(26)***

Safety Verification (1) - A structured and managed set of activities which identify the vital functions required to be performed by the system, and demonstrate that the system, including its subsystems, interfaces and components, implements the vital functions fail - safely to a level that meets the allocated system safety goals. Verification answers the question, “Did we build the system right?” ***(26)***

Safety Verification (2) - A) An incremental confidence building process or set of activities per-

formed following a given phase of system, software or hardware development to determine compliance with safety requirements established for that phase; **B)** can also be synonymous with safety validation.

Sampling Rate - The frequency with which the event recorder regularly monitors an input channel to determine its value. ***(26)***

Sanding - Dropping or blowing of sand or similar material on the top of the rail head to increase the coefficient of friction to obtain better adhesion. ***(26)***

Schedule - That part of a timetable which prescribes class, direction, number, and movement for a regular train. ***Canadian Rail Operating Rules (CROR)***

Security - Freedom from intentional danger. ***(20)***

Semantics - The relationships of symbols or groups of symbols to their meanings in a given language. ***(1)***

Semi-Automatic Switch - A yard switch equipped with a mechanism that permits an engine to trail through the switch points thus setting the switch for the route being used. *Canadian Rail Operating Rules (CROR)*

Series - In a propulsion system, the motor connection in which all motors are connected in series for the purpose of supplying them with some fraction (usually one - half) of the available voltage. ***(26)***

Server - ***Galdo***

Service - The operation of the vehicles under normal conditions with or without revenue passengers. ***(26)***

Service Braking - Any non-emergency brake application of the primary braking system. ***(11)***

Service Braking - See: brake, service. ***(26)***

Service Revenue - 1. Transit service excluding deadheading or layovers. 2. Any service scheduled for passenger trips. ***(26)***

Severity - The degree of impact that a requirement, module, error, fault, failure, or other item has on the development or operation of a system. ***(1)***

Siding (1) - An auxiliary track for meeting or passing trains. ***(2)***

Siding (2) - A track auxiliary to the main track, for meeting or passing trains, which is so designated in the timetable, GBO, train order, or DOB. ***Canadian Rail Operating Rules (CROR)***

Signal Indication (1) - The information (authorization or directive) conveyed by the aspect of a signal. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Signal Indication (2) - The information conveyed by a fixed signal or cab signal. ***Canadian Rail Operating Rules (CROR)***

Signal Inspection Act - Legislation contained in 49 U.S.C. 26 granting the Secretary of Transportation authority to require, among other things, the installation, testing, maintenance and repair of Signal and Train Control Systems. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Signal and Train Control System - A generic term used to reference existing types of signal systems, e.g., block signal systems; interlockings; automatic cab signal, train stop and train control systems; and other protective devices. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Simulator - A device, computer program, or system that behaves or operates like a given system when provided a set of controlled inputs. ***(1)***

Single Channel (Computer) System - A system incorporating one (or perhaps more) computers, each of which performs unique functions, in a single data path.

Single Track (1) - One main track on which trains operate in either direction, distinguished from double or multiple track. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Single Track (2) - One main track upon which trains are operated in both directions. ***Canadian Rail Operating Rules (CROR)***

Slide Fence - A fence erected along track to prevent rocks, mud slides, or other Asliding@ hazards from rolling onto tracks. Some slide fences incorporate detectors, which can activate wayside signals to warn approaching trains of debris blocking the track. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Slide, Wheel - During braking, the condition existing when the rotational speed of the wheel is slower than that for pure rolling contact between tread and rail/running surface. ***(26)***

Slip, Wheel - The condition existing when the rotational speed of the wheel does not correspond with pure rolling contact between tread and rail/running surface. ***(26)***

Sneak Circuit Analysis - A procedure conducted to identify latent paths which cause occurrence of unwanted functions or inhibit desired functions assuming all components are functioning properly. ***(7)***

Snow Brake - See: brake, snow. ***(26)***

Soft Failure - A failure that permits continued operation of a system with partial operational capability. ***(1)***

Soft Tree - A term coined to describe a fault tree which is constructed on a system which includes a

software interfacing with hardware. A software fault tree. ***(16)***

Software - Computer programs, procedures, rules, and possibly associated documentation and data pertaining to the operation of a computer system. ***(8)***

Software Development Cycle - The period of time that begins with the decision to develop a software product and ends when the software is delivered. This cycle typically includes a requirements phase, design phase, implementation phase, test phase, and sometimes, installation and checkout phase. ***(1)***

Software Diversity - A software development technique in which two or more functionally identical variants of a program are developed from the same specification by different programmers or programming teams with the intent of providing error detection, increased reliability, additional documentation, or reduced probability that programming or compiler errors will influence the end results. ***(1)***

Software Engineering - The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software. ***(1)***

Software Error - A design error in a system software element which, when executed, results in undesired system operation. ***(26)***

Software Life-Cycle - The period of time that begins when a software product is conceived and ends when the software is no longer available for use. The software life cycle typically includes a concept phase, requirements phase, design phase, implementation phase, test phase, installation and checkout phase, operation and maintenance phase, and, sometimes, retirement phase. ***(1)***

Software Redundancy - The existence of more than one means in software of accomplishing a given function.

Software Requirements Review (SRR) - A review of the requirements specified for one or more software configuration items to evaluate their responsiveness to and interpretation of system requirements and to determine whether they form a satisfactory basis for proceeding into a preliminary (architectural) design of configuration items. ***(IEEE Standard 610.12-1990)***
Same as Software Specification Review for DoD-STD-2167A.

Software Requirements Specification (SRS) - Documentation of the essential requirements (functions, performance, design constraints, and attributes) of the software and its external interfaces. ***(IEEE Standard 610.12-1990)***

Software Reliability - The probability of error-free operation of a computer program for a specified period of time.

Software Safety - The application of the disciplines of system safety engineering techniques throughout the software life cycle to ensure that the software takes positive measures to enhance system safety and that errors that could reduce system safety have been eliminated or controlled to an accept-

able level of risk. ***NASA Software Safety Standard, NSS 1740.13***

Software Safety Requirements Analysis (SSRA) - Analysis performed to examine system and software requirements and the conceptual design in order to identify unsafe modes for resolution, such as out-of-sequence, wrong event, deadlocking, and failure-to-command modes. ***NASA Software Safety Standard, NSS 1740.13***

Software Specification Review (SSR) - Same as Software Requirements Review. ***NASA Software Safety Standard, NSS 1740.13***

Software Tool - A computer program used in the development, testing, analysis, or maintenance of a program or its documentation. Examples include comparator, cross-reference generator, decompiler, driver, editor, flowcharter, monitor, test case generator, timing analyzer. ***(1)***

Software Verification - The process of evaluating software to determine whether the products of a given development phase satisfy conditions imposed at the start of that phase.

Software Validation - The process of evaluating software during or at the end of the development process to determine whether it satisfies specific requirements.

Source Code - Computer instructions and data definitions expressed in a form suitable for input to an assembler, compiler, or other translator. ***(1)***

Source Program - A computer program that must be compiled, assembled, or otherwise translated in order to be executed by a computer. ***(1)***

Special Protection Signal (SPS) - A stop and proceed signal equipped with a plate displaying the letters “SPS”, used to protect a train or engine occupying the main track in the block protected by the signal. ***Canadian Rail Operating Rules (CROR)***

Specification - A document that specifies in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a system or component, and often, the procedures for determining whether these provisions have been satisfied. ***(1)***

Speed, Caution - A speed that will permit stopping within one-half the range of vision of equipment or a track unit and in no case exceeding SLOW SPEED. ***Canadian Rail Operating Rules (CROR)***

Speed Control - The function of adjusting the instantaneous vehicle speed to a given speed level. ***(11)***

Speed Profile - A plot of speed against distance traveled. ***(20)***

Speed, Reduced - A speed that will permit stopping within one-half the range of vision of equipment. ***Canadian Rail Operating Rules (CROR)***

Speed, Restricted - A speed that will permit stopping within one-half the range of vision of equipment, also prepared to stop short of a switch not properly lined and in no case exceeding SLOW

SPEED. Note - When moving at restricted speed, be on the lookout for broken rails. ***Canadian Rail Operating Rules (CROR)***

Spin, Wheel - During acceleration, the condition existing when the rotational speed of the wheel is faster than that for pure rolling contact between tread and rail/running surfaces. ***(26)***

Spread Spectrum Radio - Data radio system arranged as to use a broad band width to send data in a manner reducing the effects of interfering transmissions. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Spring Switch - A switch equipped with a spring mechanism arranged to restore the switch points to normal position after having been trailed through. ***Canadian Rail Operating Rules (CROR)***

Standard Code (of operating rules) - The operating, block signal and interlocking rules of the Association of American Railroads. ***(2)***

Standard(s) - Something established for use as a rule or basis of comparison in measuring or judging capacity, quantity, content, extent, value, quality, etc. ***(23)***

Standby Redundancy - In fault tolerance, the use of redundant elements that are left inoperative until a failure occurs in a primary element. ***(1)***

State of Charge Factor - Actual capacity of a battery expressed as a percentage of a fully charged. ***(26)***
NOTE B This is based on experience, application (cycling/float service), and charging parameters.

State Diagram - A diagram that depicts the states that a system or component can assume, and shows the events or circumstances that cause or result from a change from one state to another. ***(1)***

Statement Testing - Testing designed to execute each statement of a computer program. ***(1)***

Static Analysis - The process of evaluating a system or component based on its form, structure, content, or documentation. ***(1)***

Status - The condition or state of a system, component, or parameter at a particular time. ***(26)***

Step Signal - See IEEE Dictionary. ***(26)***

Storage Rate - The frequency with which sampled signals are recorded in crashworthy non - volatile memory. The event recorder may store any signal less often than it samples. ***(26)***

Straight Air Brake - See: brake, straight air. ***(26)***

Straight Air Pipe - A method of transmitting a pneumatic command from the active cab to the straight air brake equipment on each vehicle in the operating unit.***(26)***

Stress Testing - Testing conducted to evaluate a system or component at or beyond the limits of its

specified requirements. ***(1)***

Stroke Width - In character recognition, the distance between two stroke edges, measured perpendicular to the stroke centerline. ***(26)***

Structural Testing - Testing that takes into account the internal mechanism of a system or component. Types include branch testing, path testing, statement testing. ***(1)***

Structured Analysis - A method for analyzing a problem and defining the requirements for a system. ***(25)***

Structured Design - Signal Indication - The information conveyed by a fixed signal or cab signal. ***Canadian Rail Operating Rules (CROR)***

Structured Programming - Any software development technique that includes structured design and results in the development of structured programs. ***(1)***

Subprogram - A separately compilable, executable component of a computer program. ***(1)***

Subroutine - A routine that returns control to the program or subprogram that called it. ***(1)***

Subsystem - See IEEE Dictionary. ***(26)***

Subsystem Hazard Analysis (SSHA) (1) - An analysis of the potential hazards associated with the failure modes of every component of every LRU in every subsystem within the system. ***(2)***

Subsystem Hazard Analysis (SSHA) (2) - An analysis applied to some element of the system to identify hazards associated with component failures. ***(20)***

Super-Speed - Velocity above 317 km/h (200 mph).

Supplier - The entity which contractually acts as the source of a product. **NOTE** - The supplier may or may not be the actual builder. ***(26)***

Support Software - Software that aids in the development or maintenance of other software; for example, compilers, loaders, and other utilities. ***(1)***

Switch (position) - In a propulsion system, the historic name for the lowest level of positive tractive effort and power; so called because it is typically utilized for slow-speed switching movements such as yard moves, train makeup, etc. ***(26)***

Switch (Track) - A pair of switch points with their fastenings and operating rods providing the means for establishing a route from one track to another. ***(2)***

Switch Point - A movable tapered track rail, the point of which is designed to fit against the stock rail. ***(20)***

Syntax - The structural or grammatical rules that define how the symbols in a language are to be

combined to form words, phrases, expressions, and other allowable constructs. ***(1)***

System - See IEEE Dictionary. ***(26)***

System Hazard Analysis (SHA) (1) - An analysis performed on subsystem interfaces to determine the safety problem areas of the total system. ***(20)***

System Hazard Analysis (SHA) (2) - Also called the Interface Hazard Analysis (IHA), the SHA is an analysis of the potential hazards at the interfaces within the system, and those at the interfaces with other external systems (such as propulsion control system, traction power system, communications system, etc.). ***(2)***

System Integration Testing - See Integration Testing

System Life Cycle - The period of time that begins when a system is conceived and ends when the system is no longer available for use. ***(1)***

System Safety (1) - The application of operating, technical and management techniques and principles to the safety aspects of a system throughout its life to reduce hazards to the lowest level possible through the most effective use of available resources. ***(6)***

System Safety (2) - Application of engineering and management principles, criteria, and techniques to optimize safety and reduce risks within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle. ***NASA Software Safety Standard, NSS 1740.13***

System Safety (3) - The application of engineering and management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle. ***(26)***

System Safety Goals - qualitative - A qualitative expression of the level of fail - safety which shall be achieved by a system, expressed in terms which can be realistically compared to the results of the safety verification process. ***(26)***

System Safety Goals - quantitative - A quantitative limit of the probability and/or frequency with which any vital function fails to be implemented safely. ***(26)***

System Safety Program - The combined tasks and activities of system safety management and system safety engineering that enhance operational effectiveness by satisfying the system safety requirements in a timely, cost - effective manner throughout the system life cycle. ***(26)***

System Safety Program Plan (1) - A formal document that fully describes the planned safety tasks required to meet the system requirements, including organizational responsibilities, methods of accomplishment, milestones, depth of effort, and integration with other program engineering and management functions. ***(26)***

System Safety Program Plan (SSPP) (2) - A plan that describes in detail the tasks and activities of system safety management and system safety engineering required to identify, evaluate, and eliminate

hazards, or reduce the risk to a level acceptable to the managing activity throughout the system life cycle. ***(17)***

System Testing - Testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. ***(1)***

Target Computer - The computer on which the software under development is intended to operate. ***(10)***

Test Bed (1) - As used in this report, a section of track where prototype signal systems can be installed and tested under controlled operating conditions. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Test Bed (2) - An environment containing the hardware, instrumentation, simulators, software tools, and other support elements needed to conduct a test. ***(1)***

Test Case - A set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement. ***(1)***

Testing - The process of operating a system or component under specified conditions, observing or recording the results, and making an evaluation of some aspect of the system or component. ***(1)***

Test Readiness Review (TRR) - A review conducted to evaluate preliminary test results for one or more configuration items; to verify that the test procedures for each configuration item are complete, comply with test plans and descriptions, and satisfy test requirements; and to verify that a project is prepared to proceed to formal test of the configuration items. ***(IEEE Standard 610.12-1990)***

Third Rail - An insulated electric conductor rail located alongside the running rails, from which current is collected by mean of a sliding contact mechanism attached to the bogie of electric cars. ***(11)***

Time Constant - See IEEE Dictionary. ***(26)***

Time Critical - Applications where the communications delay is bound to a fixed upper limit, independently from the load conditions. ***(26)***

Time, Dead - See IEEE Dictionary. ***(26)***

Time, Reaction - See IEEE Dictionary. ***(26)***

Time, Warm- Up - See IEEE Dictionary. ***(26)***

Timetable - The document which provides the authority for the movement of regular trains subject to the rules. It may contain classified schedules and special instructions relating to the movement of a train or engine. ***Canadian Rail Operating Rules (CROR)***

Top-Down - Pertaining to an activity that starts with the highest level component of a hierarchy and proceeds through progressively lower levels; for example, top-down design; top-down testing. ***(1)***

Topology - The geometric pattern or configuration of intelligent devices and how they are linked together for communications. ***(26)***

Traceability - The degree to which a relationship can be established between two or more products of the development process, especially products having a predecessor-successor or master-subordinate relationship to one another; for example, the degree to which the requirements and design of a given software component match. ***(1)***

Track Brake - See: brake, track. ***(26)***

Track Circuit - An electrical circuit of which the rails of the track form a part. ***(2)***

Track Occupancy Permit (TOP) - Permit(s) issued for the protection of track units and track work. ***Canadian Rail Operating Rules (CROR)***

Track Relay - A relay receiving all or part of its operating energy through conductors of which the track rails are an essential part. ***(2)***

Track Unit (TU) - A machine that operates on a railway track and is used in connection with construction or work on, or inspection of, a railway track. ***Canadian Rail Operating Rules (CROR)***

Track Warrant Control (TWC) (1) - A method of operation where the dispatcher issues mandatory directives to establish limits of movement authority between fixed points. ***Canadian Rail Operating Rules (CROR)***

Track Warrant Control (2) - A method of operation wherein the train dispatcher issues mandatory directives (track warrants) to establish limits of train movement authority between fixed points on a segment of track that may be signaled or non-signaled. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Traction System - See: propulsion system. ***(26)***

Tractive Effort - That force generated at the wheel - rail interface as a result of the action of the propulsion system. It may be either positive, indicating motoring/powering, or negative, indicating brake. ***(26)***

Traffic Control System (TCS)* - A block signal system, under which train movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following movements on the same track. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Train - A consist of one or more basic operating units. ***(26)***

Train Control System - The system for controlling train movement, enforcing train safety, and directing train operations. ***(26)***

Train Describer - An instrument used to give information regarding the origin, destination, class or character of trains, engines or cars moving or to be moved between given points. ***(2)***

Train Detection - A method by which the presence of a train in a block or its more precise location is known. ***(20)***

Trainline Interoperability - The ability of basic operating units constituting a train to communicate successfully with each other through coupler interface(s), without limitation as to the sequence or orientation of the basic operating units within the train, and without requirement for manual configuration other than optional manual confirmation of basic operating unit sequence within the train. ***(26)***

Trainline(s) - Wires and/or pipes routed though and between vehicles or units by means of couplers, jumpers, or other means so that power or signals may be transmitted to all vehicles of the train. ***(26)***

Train Order Control System (TOC) - A system in which the train order control rules apply. ***Canadian Rail Operating Rules (CROR)***

Train Orders - Mandatory directives governing the movement of trains. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Transient Error - An error that occurs once, or at unpredictable intervals. ***(1)***

Transient Fault - A fault that occurs at time t and has some finite duration Dt. ***BRS-DePaepe (Giras?)***

Translator - A computer program that transforms a sequence of statements expressed in one language into an equivalent sequence of statements expressed in another language. ***(1)***

Transponder (1) - A device encoded with an electronic message, which, upon receiving a designated signal from an interrogator, emits a radio signal conveying its message in digital form. As applied with the transponder placed in the gage of the rail or on the wayside and the interrogator placed on a locomotive, this mechanism provides information about the identification, location and operating speed (from elapsed time) of trains in equipped territory. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Transponder (2) - A device encoded with an electronic message which emits a radio signal conveying its message in digital form. ***Canadian Rail Operating Rules (CROR)***

Transport Time - See IEEE Dictionary. ***(26)***

Trap - Software feature that monitors program execution and critical signals to provide additional checks over and above normal program logic. Traps provide protection against undetected software errors, hardware faults, and unexpected hazardous conditions. ***NASA Software Safety Standard, NSS 1740.13***

Triangulation (1) - The use of wireless technologies that perform triangulation which relates an on-track movement to a specific location. ***PTC Supplier Q=s***

Triangulation (2) - A process in which relative distance or position relative to multiple electronic reference points is determined by wireless technologies, and used in combination with a track database to help determine location of a vehicle. ***Bob Heggestad B Harmon***

Triple Modular Redundancy (TMR) - A type of redundancy in which the outputs of three or more channels are voted upon by a voter, which takes on the majority decision and latches out the disagreeing channel output; also known as two-out-of-three voting.

Trip Switch/cock - A device mounted on the truck of a vehicle, responding to a raised arm on the wayside, used to cause an emergency brake application if a train attempts to pass a mandatory stop signal. ***(26)***

Truck - A rail vehicle component that consists of a frame, normally two axles, brakes, suspension, and other parts, which supports the vehicle body and can swivel under it on curves. If powered, it may also contain traction motors and associated drive mechanisms. ***(26)***

Turnout - A curved track leading from one track to another; an arrangement of a switch and a frog with closure rails by means on which rolling stock may be diverted from one track to another. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***
UHF - Ultra High Frequency. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Unit - See: basic operating unit. ***(26)***

Unit Testing - Testing of individual hardware or software units or groups of related units. ***(1)***

Unsafe (1) - Having unacceptable risk of conditions which could cause death, injury, property damage, or environmental damage. ***(26)***

Unsafe (2) - Any condition, either external or internal to a given system, which results in an operational mode that has a non-zero probability of an unacceptable catastrophic failure. This catastrophic failure results in an unacceptable damage to the environment, equipment, or life. ***BRS-DePaepe (Giras?)***

Validation - The process of determining whether the system or component complies with the objectives and system requirements during and/or at the end of the development cycle. That is... Adid we build the right system?@ ***PTC Implementation Task Force***

Vehicle - A land conveyance assembly for carrying or transporting people or objects, capable of traversing a guideway, having structural integrity and general mechanical completeness but not necessarily designed for independent operation. ***(26)***

Verification - The process of determining whether the system or component outputs of a given phase of the development cycle fulfill the requirements established at the start of that phase. That is... ADid we build the system correctly?@ ***PTC Implementation Task Force***

Very-High Speed - Velocity in the range of 198 km/h (125 mph) to 317 km/h (200 mph).

VHF - Very High Frequency. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Vital (1) - Describes a function in ATCS, PTS, PTC, and ITCS, that could result in a physical conflict or other operational hazard of similar magnitude if an unsafe failure (including design error) occurs. ***Canadian Rail Operating Rules (CROR)***

Vital (2) - Essential to safe train operations**.** ***(18)***

Vital Circuit or Component - Any device, circuit or software module used to implement a vital function. ***(20)***

Vital Function (1) - A function in a safety critical system which is required to be implemented in a fail-safe manner. ***(26)***

Vital Function (2) - A function critical to safety, performed by a system, subsystem, piece of equipment, or component.

Vital Function (3) - A function in a safety critical system which is required to be implemented in a fail - safe manner. ***(26)***

Vital Relay - A relay, meeting certain stringent specifications, so designed that the probability of its failing to return to the prescribed state upon de-energization is so low as to be considered practically nonexistent. ***(11)***

Volatile (Memory) - Memory that requires a continuous supply of power applied to its internal circuitry to prevent the loss of stored data. ***(10)***

Voting - A scheme in which the outputs of three of more channels of a system implementation are compared with each other in order to determine agreement between (usually) two or more channels, and to permit continued operation in the presence of a malfunction in one of the channels. A degree of fault tolerance is thereby obtained. ***(18)***

Waiver - A variance that authorizes departure from a particular safety requirement where alternate methods are employed to mitigate risk or where an increased level of risk has been accepted by management. ***NASA Software Safety Standard, NSS 1740.13***

Walkthrough - A static analysis technique in which a designer or programmer leads members of the development team and other interested parties through a segment of documentation or code, and the participants ask questions and make comments about possible errors, violation of development standards, and other problems. ***(1)***

Watch-dog (Timer) - A device (usually in hardware) which monitors a prescribed (continuous or periodic) operation of computer hardware and/or software and provides an indication when such operation has ceased.

Wayside Control - A Acommand and control system@ whereby electronic and/or mechanical devices alongside the guideway execute all or part of the necessary decisions inherent in command and control of the vehicles. ***(11)***

Wayside Equipment - Train control or movement apparatus which is located along the track or wayside as opposed to the control center or other remote location. ***(20)***

Wayside Interface Unit (WIU) (1) - An ATCS field system providing the interface with the switches, signals, grade crossings, etc., for continuous monitoring and communication of their status to central control office, locomotives and for other uses. ***Canadian Rail Operating Rules (CROR)***

Wayside Interface Unit (WIU) (2) - An element of a PTC field system providing the interface with switchers, signals, grade crossings and other devices for continuous monitoring and communication of their status to the central control offices, locomotives, and other users. ***1994 Report to Congress***

Wayside Interface Unit (WIU) (3) - An element of an ATCS field system providing the interface with switches, signals, grade crossings and other devices for continuous monitoring and communication of their status to the central control offices, locomotives and other users. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Wayside Interface Unit Server (WIU-S) - computerized equipment, which transmits information about WIU=s to an approaching train. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Wayside Local Area Network (WLAN) - the WIU to WIU-S=s link using spread spectrum radio. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Wayside Signal - A signal of fixed location along the track right-of-way. ***(15)***

Weak Field - In a propulsion system, a motor connection or operating mode in which the exciting field current is less than the full field value. ***(26)***

Weight, Actual - The measured weight of a finished, ready - to - run vehicle; the tare weight. ***(26)***

Weight, Crush Loaded - The weight of a vehicle when loaded with crew, all seats occupied, and standees to a specified number. ***(26)***

Weight, Empty - See: weight, actual. ***(26)***

Wheel Diameter Compensation - A function which corrects for either the wear of the wheel(s) or the difference(s) in rolling diameter between different wheels on the vehicle or both. ***(26)***

White Box Testing - Testing that takes into account the internal mechanism of a system or component. Types include branch testing, path testing, and statement testing. ***(1)***

Work Order Reporting - A business-related function of ATCS, which provides communication

between the crew of a train and a central point, by digital data radio, related to pick-up and set-out of rail cars at shipper and consignee locations and handling of cars at yards and terminals en route. ***FRA=s 1997 Draft Progress Report to Congress on Positive Train Control Systems***

Yard - A system of tracks within defined limits for making up trains and storing cars. ***(20)***

Yard Speed - A speed, used within yard limits, that will permit stopping within one-half the range of vision. ***(20)***

* Denotes requirements of the Code of Federal Regulations (CFR) at Title 49, Part 236 - RULES, STANDARDS, AND INSTRUCTIONS GOVERNING THE INSTALLATION, INSPECTION, MAINTENANCE, AND REPAIR OF SIGNAL AND TRAIN CONTROL SYSTEMS, DEVICES, AND APPLIANCES (RS&I).

DRAFT

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